Nature

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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—Wordsworth

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, NOVEMBER 5, 1908.

ALTERNATION OF GENERATIONS IN PLANTS.

The Origin of a Land Flora. A Theory based upon the Facts of Alternation. By Prof. F. O. Bower, F.R.S. Pp. xii+727; with numerous illustrations. (London: Macmillan and Co., Ltd., 1908.) Price 17*s*. net.

THIS important book, embodying the results of the author's well-known morphological researches during the last twenty years, may be regarded from two points of view. On the one hand, it forms a most excellent manual of comparative morphology for the groups dealt with—essentially the higher cryptogams; on the other, it gives the final statement of those theoretical views on the alternation of generations in plants with which Prof. Bower's name is associated and of which he is the leading champion. The two aspects cannot, however, be kept separate; the theory forms the thread on which the facts are strung, and without the theory we should not have had those researches which have so greatly enlarged our knowledge of the facts. In this way the "working hypothesis" has fully justified its existence, and all botanists owe a debt of gratitude to the author for the theory which he has so systematically worked out, as well as for the detailed investigations to which it has been the guide. No more important contribution to scientific botany has appeared in England since the revival of botanical research in this country in the 'seventies of the past century.

It is needless to say that the author's presentation of the facts is everywhere scrupulously fair; his book may be used with profit and pleasure alike by those who accept and those who dissent from his main position. The reviewer cordially agrees with the concluding sentence of the preface:—

"Whatever view be ultimately taken of the prime origin of the alternating generations, many of the conclusions arrived at here as to the morphological progress and phyletic grouping of the Archegoniatæ will stand: they have a validity of their own quite apart from any question of the ultimate origin of the sporophyte, which has finally become the dominant factor in the flora of the land."

The book is divided into three parts:—Part i., statement of the working hypothesis, 20 chapters, 254 pp.; part ii., detailed statement of facts, 20 chapters, 402 pp.; part iii., conclusion, 7 chapters, 60 pp.

This arrangement involves a certain amount of repetition, but, on the whole, is well adapted to the purpose of the book, which is to state the main theory with its subsidiary hypotheses, and to test them fully in their application to the morphological data.

In considering the book critically, attention will be chiefly directed to its theoretical side. The reviewer is one of those who are unable to accept the chief conclusions of the author, and hence it is impossible altogether to avoid controversy. From what has already been said, it will be clear that theoretical differences in no way affect the high estimate of the value of Prof. Bower's book which every unbiased reader must form.

After an introductory chapter on the scope and limitations of comparative morphology, the life-history of a fern is appropriately given the foremost place as the type of the regular alternation of sexual and asexual generations which characterises the higher plants. In the ferns and the vascular plants generally the asexual generation is the plant itself, with all its elaboration of vegetative organs, while the sexual phase is represented by the comparatively small and simple prothallus. In the Bryophyta (mosses and liverworts), on the other hand, the balance of the two generations is reversed, the main vegetative development falling in the sexual stage, while the asexual generation is merely a fruit (sporogonium) dependent throughout life on the sexual plant which bears it. In both classes "there is thus a marked difference between these two phases, and their sequence may be said to constitute an *antithetic alternation*" (p. 32). Here, and in some other passages (*e.g.* p. 658), the phrase "antithetic alternation" is used simply to express the known facts

of the life-history; elsewhere, however (as on p. 150), the words are employed in a different sense, namely to indicate the author's theory that the asexual generation has been intercalated in the life-cycle, and is therefore newer than the sexual phase or gametophyte. To avoid confusion it will be best to speak of this view as the "intercalation theory," though the term "antithetic" has come to be identified with it. The significance of the title, "The Origin of a Land Flora," lies in the fact that the sexual generation retains, at least throughout the archegoniate cryptogams, the primitive method of fertilisation by spermatozoids, requiring the presence of water, while on the other hand the asexual phase, with its wind-scattered spores, is essentially adapted to a terrestrial life. Hence the author speaks of the alternation as "amphibious," an appropriate phrase which may be readily adopted, whatever view be taken of the origin of the two generations. The asexual sporophyte, however it may have arisen, conquered the dry land; the gametophyte, with its conservative adherence to traditional methods, remained dependent on a more or less watery environment, until the seed-plants came to be evolved. Then the prothallus became a mere parasite on the sporophyte, enclosed within the megasporangium, so that fertilisation could take place on the plant itself. Spermatozoids were retained in the more primitive types (cycads, Ginkgo, and no doubt many fossil seed-plants), but their swimming was now confined to a water-drop secreted within the ovule; in the rest of the Spermophyta they have dropped their now useless motility, and fertilisation, like the other vital processes, has become thoroughly adapted to terrestrial conditions.

All this is admirably told in Prof. Bower's book, and it is to him that the credit belongs of realising the essential biological significance of alternation of generations as it exists in the higher cryptogams.

The question at issue relates to the origin of the alternating generations. On the intercalation hypothesis, maintained by Prof. Bower in agreement with Celakovsky and some other morphologists, the sexual generation represents the original plant, which alone existed in the presumed ancestor, while the asexual sporophyte is a new development, an intercalation, arising from the elaboration of the fertilised ovum or zygote, first into a mass of spores, and ultimately into a complex sporogonium on the one hand or a spore-bearing plant on the other.

The strength of the intercalation theory lies in the evidence afforded by certain liverworts (Ricciaceæ), in which the sporogonium actually consists of nothing but a spherical mass of spore-mother-cells, enclosed in an ephemeral epidermis. So simple a body might well have arisen as a new formation, as a fruit-body replacing an oospore, a development for which various apparent analogies have been traced among thallophytes. From the Ricciaceæ there are found sufficiently continuous series of forms, leading up to the fully differentiated capsules of the higher liverworts and the mosses. Hence the intercalation theory appears quite credible for the Bryophyta, and some botanists have accepted it for that class while rejecting it for the Pteridophyta.

Even as regards the Bryophyta, however, everything depends on the primitive nature of the Ricciaceous sporogonium, and this is open to doubt. As the author himself says (p. 237):—"It may be a question whether the absence of a nutritive system is due here to reduction, or is itself the primitive state." Though "the latter is the view usually accepted," there is good evidence for reduction in related liverworts (Cyathodium, pp. 237 and 263), and in Riccia itself the transitory nature of the sporogonial wall (p. 257) may well indicate a secondary loss or change of function, as we see in the case of the nucellus of so many angiospermous ovules. There are good grounds for holding that far-reaching reduction has gone on even among the higher Bryophyta, and, on the whole of the evidence, the idea of ascending series within this class, starting from the simplest form of sporogonium, cannot be considered as by any means established. In fact, the Bryophyta, which have long been regarded as affording the clue to the interpretation of the life-cycle of the higher plants, themselves stand in need of interpretation, even more than other groups.

Among the Vasculares, the sporophyte is always (even in *Lycopodium Selago!*) a highly organised plant, and no one would dream of attributing its origin to an intercalation, if it were not for the analogy of the bryophytes.

During the last fifteen years the cytological distinction between the two generations has played an important part in the controversy as to their nature. In all normal cases the asexual generation is "diploid," its nuclei having twice as many chromosomes as those of the "haploid" sexual phase. Reduction takes place in the spore-mother-cell, at the initiation of the gametophyte. This side of the subject is very ably treated by Prof. Bower, who continues to attach considerable importance to the cytological distinction, in spite of the exceptional cases recently brought to light, where it has been shown with certainty that the gametophyte generation may be diploid, and, with great probability, that the sporophyte may be haploid. Such cases are associated with the occurrence of apospory (suppression of spore-formation) and apogamy (suppression of sexual reproduction) in the same life-cycle, as happens in various anomalous ferns. These observations prove that there is no necessary connection between the number of chromosomes and the morphological characters of the alternating generations, but "cannot be held to invalidate the view that the cycle as above stated existed in all probability throughout the earlier phases of descent of the Archegoniatæ" (p. 62).

The cytological distinction was at one time regarded as supporting the opinion that the two generations were distinct in origin, and thus as favouring the intercalation theory. This can no longer be maintained, since it has been shown by Lloyd Williams and Mottier that in the alga Dictyota there is a regular alternation between the haploid sexual and the diploid asexual generation, generations which in all morphological respects are perfectly similar to one another. There can be no question of intercalation

here, and the case of Dictyota (as well as the more complex case of certain Florideæ) shows that the cytological distinction may exist between generations which are clearly homologous with one another. The author explains the similarity of the two generations in such cases by the similarity of the conditions to which they are exposed (p. 81). We can well understand (though this is not the author's view) how, when the conditions became different, as in the Archegoniatæ, generations likewise homologous may have come to be sharply differentiated. The author, in chapter v., gives an admirable account of the facts, but perhaps hardly realises how unfavourable they are to the theory of intercalation.

There appears to be no satisfactory case among the Thallophyta of the origin of a diploid asexual phase by intercalation, unless it be among certain fungi, too remote from the archegoniate series to afford any serviceable analogies.

The fruit-body of the green alga Coleochæte, formerly regarded as comparable to a simple bryophytic sporogonium, has been shown by Allen to have haploid structure, reduction taking place on the first nuclear division in the germinating zygote (p. 73). Hence this time-honoured comparison will no longer hold good, though some biological analogy may still be traced.

So far as the evidence from the Thallophyta is concerned, it seems that recent work favours the origin of the alternating generations by the modification of homologous individuals rather than by the intercalation of an entirely new phase in the life-cycle.

Those morphologists who maintain the intercalation hypothesis differ among themselves as to the relation between the leafy sporophyte of the higher plants and the sporogonium from which they believe it to have been evolved. To some, the leaf is the primary structure, derived directly from the sporogonial head, and the axis is entirely subsidiary (Celakovsky and Worsdell), while on Prof. Bower's view the axis is primary, the leaves (sporophylls) arise from it *de novo*, by "enation," and the roots are likewise accessory. The author lays great stress on the predominance of the axis, as the foundation of his "strobiloid" theory, according to which the whole plant represents an elaborated strobilus, which in its turn was derived from a simple sporogonium-like fructification. He supports his view by a wealth of argument, based on anatomy, embryology, and comparative morphology (see especially chapter xi., the theory of the strobilus). All this, however, is subsidiary to the main question. The predominance of the axis is no necessary part of the "antithetic theory," nor is it in any way opposed to the homology of the sporophyte with the vegetative body of the lower plants. We see quite clearly among the Bryophyta how, starting from a thalloid structure, the axis may become predominant, and analogies are not wanting among the Thallophyta also.

We will not, however, pursue these controversial matters further. Prof. Bower deals in the fullest manner with a great problem, and nothing could be better than the way in which he states his case. He is not, perhaps, quite so happy in his treatment of alternative hypotheses, which he sometimes dismisses rather curtly, though to many botanists they will appear worthy of more serious consideration. The question, as the author points out, scarcely admits of any final solution. The gaps in the evidence are such that no theory (least of all the author's) can dispense with the postulation of "hypothetical organisms," nor have we much reason to hope that the fossil record will ever supply a more substantial ancestry.

The second and longest division of the book, the detailed statement of the facts, will probably prove of most value to the student, for it gives a full account of the morphology, anatomy, and embryology of the sporophyte of the Archegoniatæ (including extinct groups), with incidental references to the other generation. Here also the strobiloid theory permeates the whole, and great importance is attributed to the *Lycopodium Selago* type, as the best living representative of the hypothetical "strobiloid condition" in which all the leaves were sporophylls. A figure of this species forms the frontispiece to the book.

The Sphenophyllales (including Psilotaceæ) and Equisetales are appropriately grouped together under the head of "Sporangiophoric Pteridophyta," characterised by the sporangia being borne on definite outgrowths from the axis or leaf, the peltate scales of an Equisetum affording the most familiar example. The author maintains at length the view that the sporangiophore is an organ *sui generis*, not homologous with a leaf or leaf-lobe, a position which is tenable and simple, but not wholly convincing to those whose point of view is different from that of the strobiloid theory.

The Ophioglossaceæ are treated in much detail; the author upholds his well-known opinion that this family forms, as a whole, an ascending series, probably derived from some sporangiophoric type comparable to that of the Psilotaceæ or other Sphenophyllales. He thus makes the series a parallel development to the ferns, without actual affinity with them. The alternative, and, in the reviewer's opinion, more probable view, that the Ophioglossaceæ are derived from a somewhat primitive group of ferns, not very remote from the Botryopterideæ, is not discussed. The author argues vigorously against saprophytic reduction as a factor of any importance in the evolution of this family, though in his description of *Ophioglossum simplex* he has himself supplied the most convincing proof that such reduction has occurred in an extreme degree. The extraordinary embryology of the genus Ophioglossum (the embryo in some species consisting of a root and nothing else) appears to indicate that we are here dealing with very highly modified plants, and by no means with types of primitive simplicity.

The account of the ferns is extremely full and interesting, and less influenced by theoretical considerations than the rest of the book. The author's classification of the homosporous ferns according to the arrangement and succession of development of their sporangia was first published in 1899, and has been recognised as a convenient and natural grouping. The three series are characterised as follows (p. 497):—

The Simplices, in which the sporangia of a sorus

are produced simultaneously; the Gradatæ, in which there is a definite succession in time and space; and the Mixtæ, in which there is a succession in time, but no regular succession in space.

"These three types appeared successively in geological time: the Simplices were the characteristic ferns of the primary rocks, though many of that type still survive; the Mixtæ are the dominant ferns of the present day, while the Gradatæ take a middle place."

The scheme on p. 653, showing the approximate relations of the several families of ferns, will be of great service to students of this class (now more important than ever to the morphologist). Altogether, the author's account of the filicales is no doubt the best yet published.

The concluding part of the book gives a full and final statement of the author's theoretical position, and is the part which will most appeal to the reader whose interest lies mainly in the theory rather than the details. Enough, however, has been said on the points in dispute; any attempt at a full discussion would far exceed the limits of a review.

The book is excellently got up, with abundant and admirable illustrations throughout. It is almost free from misprints. One, however, occurs in an important passage on p. 237, where "Riccia cell" appears to be a printer's error for "Ricciaceæ."

Nothing can be better for English botany than the appearance of such a book as this, a full and most original treatise on an important branch of the science by one who is an acknowledged master of his subject. Prof. Bower is to be warmly congratulated on this, the latest product of his energy and devotion to research.

D. H. S.

WINDMILLS AND WATER-WHEELS.

Natural Sources of Power. By R. S. Ball. Pp. xvi+348. (London: A. Constable and Co., Ltd., 1908.) Price 6s. net.

THE classification of a source of power as a "natural" one is purely arbitrary. The distinction would imply that a source of power could be "artificial," which would, of course, contradict the first law of thermodynamics. The author of the present volume simply uses the word to describe those sources of power which provide us directly with mechanical energy without any intermediate transformation, such as combustion or the like; and the two particular supplies of energy to which attention is directed are wind-power and water-power.

As is natural, the author commences his book with a reference to the, said to be, not distant day when all the coal, and all the oil, in the world will have been used up, and mankind, in order to sustain itself, will have to rely wholly upon the water-wheel and the windmill for that tremendous amount of energy which will be necessary to keep the immense population of the earth in the state of comfort to which it has, with the progress of civilisation, attained. It is an interesting speculation to picture to oneself what the state of the world will be when this prophesied day arrives, and the coal-measures of the world have disappeared. Will the great manufactures migrate from Lancashire and Northumberland to Norway, Italy, and the West of Ireland, or will, ere that day arrives, our cotton mills and blast furnaces be run by radium engines, utilising sources of energy which are at present wholly unexploited? Certainly, nobody who has studied the development within the last few years of the science of radio-activity will be prepared, out of hand, to deny the possibility.

It is rather surprising to be told that the demand for windmills was never so great as it is to-day, or the trade of the manufacturer of such motors never so brisk. On the other hand, evidences of the utilisation of the water-powers of the world are everywhere abundant, the chief agent in this being the development of electrical technology. A book, therefore, such as the one under review, dealing with these subjects in an easily understandable manner, is to be accorded a welcome. The style of the book, while being simple, is yet not entirely popular. It is not a complete treatise, a certain amount of elementary mathematics is necessary, but the calculus is not used, the author giving a general review of his subject, with the object of showing the desirability of not allowing the many small sources of wind- and water-power which exist to run to waste. The book can be specially recommended to those readers who, while not being specialists in the particular branch dealt with, desire to obtain a general survey of the subject.

The first chapter deals with general principles, such as the distinction between "power" and "energy," efficiency of machines, units, &c. The discussion of the electrical units of energy on p. 7 is hardly happy. This, we think, is due to the author placing in juxtaposition the "foot-pound" and the "watt," which latter, he says, is "allied to a power unit." The confusion in electrical units of power, which the author mentions, is, we think, entirely of his own creation. The watt is not "allied" to a power unit, but is actually the electrical unit of power, there being really no confusion in the matter at all.

Chapter ii. is concerned with "water power and methods of measuring." As is only fit, the fundamental theorem of Bernouilli, which says that the sum of the pressure head, the velocity head, and the height above datum level is the same at all points in a pipe running full of water, is stated and discussed, as are also weirs and the general principles of surveying as called for in the lay-out of a water development scheme.

Subsequent chapters deal with the different kinds of water-wheels and hydraulic turbines, their general design, theory and regulation. The construction of water-power plants and the fundamental principles of dams are also referred to, while descriptions of several typical installations working under such widely different conditions as heads of 2 feet and 2000 feet are given.

The last 120 pages of the volume discuss windmills and wind-motors. It is stated that there is a rapid extension and enormous trade done in small windmills. These are used chiefly in the great agricultural countries for pumping purposes, and the attempt made to utilise such motors for driving electrical generators

has not met with any serious measure of success. It would appear that wind-motors have not yet been subjected to much scientific study. As regards the old type of windmill with four sails, as is usually seen in the eastern counties of England, the rules given by Smeaton in the year 1759, as the result of experiments, embody the chief data available.

The modern or "American" windmill forms the subject of the last two chapters. Many interesting constructional details are given, as well as particulars of tests on the power developed and the cost thereof when applied to different industrial purposes. These chapters can be recommended to those who desire to acquaint themselves with this somewhat out-of-the-ordinary branch of modern mechanics. C. C. G.

NEUROLOGY.

Functional Nerve Diseases. By A. T. Schofield. Pp. iv + 324. (London: Methuen and Co., n.d.) Price 7*s.* 6*d.* net.

DURING recent years Dr. Schofield has written many books on different forms of nervous disorder, but the present volume is one of the most interesting. Here he deals with the so-called "functional" nerve diseases. This term "functional," although open to many objections, is a useful one, for by it we can convey that the ailment in question belongs to that class of disease which is independent of gross morbid anatomy changes. The author states it thus:—"that organic changes exist when life has passed but functional changes have then all disappeared." Later, he goes on to say that "disease, *au fond,* has always a material basis, whether recognisable or not, and 'functional' and 'organic' are but expressions of our ignorance that will one day be superfluous." The "Psychology of the Brain" is the subject-matter of one of the opening chapters. Dr. Schofield does not attempt to go deeply into any psychological problems; in truth, he deals with this subject almost too widely to be entirely helpful to the reader. He divides the brain into three main divisions:—(1) The cortex, as the seat of the spirit or directing intelligence; (2) the mid-brain, the seat of the soul or the mere active animal life; (3) the lower-brain, which is the seat of the body or the mere physical existence. The author definitely states that he writes this book from the dualist standpoint; "that is, in the belief that mind is not the product of matter, but distinct from it, and that life is mind in action." He urges upon the student to get rid of the idea that *consciousness* is mind or that it is the only proof of mind. "Mind," he writes, "may be conscious, subconscious, or unconscious." But he only uses these terms provisionally until it is possible for the student to understand that mind means *all* mind, and not only that part of it which we choose to call consciousness. When discussing the general ætiology of functional nerve diseases Dr. Schofield writes:—

"In functional disease the underlying change is often in the association of cells rather than their structure, for we must remember that the association of neurons is not organic but functional."

He deals with the varied recognised factors in the causation of this class of disorder, and among these he mentions the influence of "suggestion." This, he says, may be from oneself (auto-suggestion) or from others, but the former is the more frequent. When treating with the causes of hysteria, the author recites the various views held by recognised writers. He regards "heredity" as the principal and general predisposing cause of neurasthenia, a prominent factor being alcoholism in the ancestry of the patient. The author gives a useful chapter on the symptoms of neurasthenia, but he adds nothing new to the subject. When dealing with "psychotherapy" the various objections to it in this country are referred to, and Dr. Schofield evidently deplores that the influence of the mind over the body is not more fully taught to students at the hospital. He denies that "suggestibility" is a symptom of hysteria, as taught by Charcot, and points out that it is often easiest in the sound and the sane, more difficult in the neurasthenic or hysteric, and almost impossible in the insane. We do not agree with the views that he expresses on the importance of massage in all cases, for we are convinced that this treatment is very harmful to some patients as merely increasing the nervo-muscular irritability. Taken as a whole, the book is well written and full of useful information, and it will be found to contain many suggestions which will prove of value to the thoughtful student.

OUR BOOK SHELF.

Trout Waters: Management and Angling. By Wilson H. Armistead. Pp. x+203. (London: Adam and Charles Black, 1908.) Price 3*s.* 6*d.* net.

THIS is a pleasantly discursive little book, which is obviously based upon considerable personal observation and experience on the part of the author. We doubt, however, whether Mr. Armistead was altogether wise in avoiding all books of reference, as he states himself to have done; a book of reference would have prevented the same mollusc from figuring as "*Limnaeus peregra*" and "Limnea" in consecutive paragraphs.

The advice given as to improving and protecting trout in various waters is on the whole sound and sensible; the suggestions that minnows introduced to feed large trout may seriously compete with smaller trout for the available food supply, and that eels are dangerous enemies of the ova and fry of trout and may do more harm than pike or perch, are fair examples of the many practical matters touched upon. It is a pity that no directions are given as to simple and inexpensive forms of hatching apparatus, such as Herr Jaffé's "floating redd," which would seem well suited for use in many such waters as are considered in the work now under consideration.

It is when Mr. Armistead touches upon the natural history of the Salmonidæ that the lack of books of reference is most apparent. The statement that "fry hatched from eggs taken from wild parents are, though strong and healthy, difficult to rear on account of their inherited wildness" is somewhat startling. A chapter is devoted to the consideration of the question whether the presence of trout in a salmon river is or is not a disadvantage, and the question is treated in a thoughtful manner; it is, however, a little surprising to learn, not only that migratory

Salmonidæ will and do continually cross with the river trout, thus making the identification of the offspring difficult, but that "the difficulty of identification is increased when one has to deal with quarter-breeds or with the progeny of a half-bred trout and salmon and a full-bred salmon." The last quoted statement is unsupported by any evidence save that the author has seen brown trout "doing duty on the salmon redds," and occurs in a chapter in which it has already been stated that "the spawning seasons of the two fish (trout and salmon) seldom coincide." We cannot help thinking that the existence of these "quarter-breeds" is the merest matter of speculation, and believe that no serious angler or ichthyologist will credit their existence until specimens have been submitted to expert examination.

The general get-up and printing of the book is worthy of the publishers whose name it bears, but the use of the back of a map, showing existing hatcheries, as an advertising space for one of these hatcheries is to be deprecated. L. W. B.

The Lore of the Honey-Bee. By Tickner Edwardes. Pp. xxiv+281. (London: Methuen and Co., n.d.) Price 6s.

THIS book begins with an entertaining account of the curious beliefs about bees held by the ancients and in the Middle Ages, such as their spontaneous generation from the carcass of an ox, as recorded by Virgil and others, and the government of the colony by the queen and her subordinates.

"The single large bee, which all knew to exist in each hive, was generally looked upon as the absolute ruler of the community. It is variously described as a king or queen by writers in the sixteenth and seventeenth century, but only in the sense of a governor; and the word chosen largely depended on the sex of the august person who happened to occupy the English throne at the time."

The greater part of the work consists of a picturesque description of different aspects of bees and bee-keeping at the present day. Mr. Edwardes is a charming writer, and the now well-ascertained facts of bee-life are prettily treated by his romantic pen. The author thinks that the "atmosphere of poetry and romance ought to be held inseparable, now as ever, from a craft which is probably the most ancient in the world." Mr. Edwardes's argument that bees are guided by reason rather than by instinct is not confirmed by close observation.

As regards the commercial possibilities of bee-keeping, the author truly says that "tons of honey are annually running to waste. All this could be garnered and sold to the people at little trouble and great profit." And "just as there is nothing like leather, beeswax holds its own as a marketable commodity in spite of paraffin substitutes."

The last chapter of the book is devoted to showing how admirably bee-culture is adapted to the practice of the simple life.

There are twenty-four fine full-page photographs.
F. W. L. SLADEN.

Elements of Water Bacteriology, with Special Reference to Sanitary Water Analysis. By Prof. S. C. Prescott and Prof. C. E. A. Winslow. Pp. xii+258. Second edition, re-written. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 6s. 6d. net.

THE sanitary examination of water supplies by bacteriological methods is becoming of increasing importance. In this country extensive researches have been, and are being, carried out for the Local Government Board, for the Sewage Commission, and for the Metropolitan Water Board. In America also much attention and research are being devoted to the bacteriological examination of waters, and the book under review gives a good summary of American views, procedure, and technique relating to this subject. On the whole, British and American procedures are very similar, and the characters which are recognised by both as belonging to the typical *Bacillus coli*, so important a factor in all examinations, agree fairly closely. This is important, as it renders results obtained in both countries more comparable than otherwise might be the case.

In the first chapter the natural bacterial flora of waters, its variation under different conditions, and influences modifying it, are discussed. The quantitative bacteriological examination of water is considered in the next and succeeding chapters, namely (1) the estimation of the number of organisms that develop aërobically on gelatin at room temperature (20° C.); (2) the estimation of the number of organisms that develop aërobically on agar at blood heat (37° C.); and (3) the search for the *Bacillus coli*, and its isolation and quantitative estimation if present. As regards *Bacillus coli*, the American standard seems to be more lenient than ours; for it is suggested that only if this organism is present in 1 c.c. or under should the water be considered to be unsafe. The chapter on the significance of *Bacillus coli* is well thought out and instructive.

Finally, the methods of isolation of the *Bacillus welchii* (*enteritidis sporogenes*), streptococci and pathogenic organisms such as *Bacillus typhosus* and *Vibrio cholerae* are fully discussed. The book can be recommended as a very useful one and a great improvement on the first edition; the numerous tables, formulæ for media, and bibliography enhance its value. R. T. HEWLETT.

The National Physique. By A. Stayt Dutton. Pp. xii+188. (London: Baillière, Tindall and Cox, 1908.) Price 5s. net.

A CONSIDERABLE practice in different parts of England and Wales has enabled Mr. Dutton to form an idea of the causes and remedies of the physical deterioration of which we hear so much nowadays. The book he has produced is a sensible little brochure, remarkably free from technicalities, and easily understood by the man in the street. It deals with the elementary questions of physiology which underlie the teachings of hygiene, and gives a good deal of practical advice on the measures to be adopted (diet, fresh air, exercise, pure water, disinfection, and the like) which would ensure the health of the people and the improvement of the race.

The main underlying idea of the book is the importance of anæmia as a factor in the causation of a deterioration of the national physique, and the consequent importance of improvement in the state of the blood in any efforts to counteract malnutrition and its consequences. The old idea that "the blood is the life" is now relegated to advertisements of quack remedies; but there is no doubt that impoverishment of the nutrient stream is a readily available guide in any state of poor development or enfeebled health, whatever the ultimate cause of such a condition may be. The author in some cases, perhaps, pushes his idea too far, as, for instance, when he regards anæmia as the prime moving cause in producing myopia. Still, the book is, as before stated, on the whole, judicious and well-balanced. We can only hope that its precepts may be taken to heart by the people at large, and by the legislature. W. D. H.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE.

Anomalous Dispersion of Luminous Hydrogen.

ON pp. 413 and 607 of vol. lxxvii., and p. 55 of vol. lxxviii., of NATURE, Prof. Schott and Mr. Norman Campbell discuss the question of "The Theory of Dispersion and Spectrum Series." Though not desirous of re-opening this discussion, we think the readers of NATURE may take some interest in the results of experiments we have just finished upon the anomalous dispersion of luminous hydrogen.

We used the continuous spectrum given by a narrow capillary tube when filled with hydrogen at nearly atmospheric pressure, and traversed by a convenient current given by a large induction coil. In that spectrum we generated horizontal interference fringes by using a Jamin interferential refractor (*cf.* L. Puccianti, *Nuovo Cim.*, ii., p. 257, 1901), and we sent one of the two rays between the Jamin mirrors through a Geissler tube filled with hydrogen of about 4 mm. pressure.

When this tube is put in series with the capillary tube above mentioned, the interference fringes at both sides close to the red hydrogen line (Hα) suddenly change their direction, as in the accompanying figure, showing directly the

6708 (Li) 6563 (Hα)

anomalous course of the refractive index near the "absorption line." By measuring the maximum variation of the refractive index (8×10^{-7}) and the breadth of the Hα line (2–3 Å) we find, according to the Drude-Voigt theory of dispersion (*cf.* W. Voigt, "Magneto u. Electro-optik," p. 114, 1908), that the ratio of the number of "electrons of dispersion" to that of molecules of hydrogen is only about 1 to 50,000, and that the damping-constant (*cf.* Voigt), measured in wave-lengths, is of the order 2–3 Ångström units.

We have not succeeded in detecting anomalous dispersion at the other hydrogen lines, which is expected to be much smaller than that at the Hα line, on account of the smaller absorption (*cf.* R. Ladenburg, *Verh. d. deutschen phys. Ges.*, x., p. 550, 1908).

We conclude that our experiments show that it is not possible to explain the dispersion of luminous hydrogen by the existence of one class of electrons only as in the case of non-luminous hydrogen; we have to introduce new "electrons of dispersion," and the frequencies of these seem to be those of the lines of the so-called first series of hydrogen.

RUDOLF LADENBURG.
STANISLAW LORIA.

Physical Laboratory, University of Breslau,
October 17.

The 4·79 Period of Sun-spot Activity.

IN NATURE of August 13 (p. 351) the photograph is published of two groups of sun-spots taken on August 6, and attention is directed to the remarkable fact that such an outbreak should occur two years after the sun-spot maximum. This renewed sun-spot activity is connected with the 4·79 period, which I have shown to have been quite persistent—even more so than the eleven-year period—since sun-spots were first systematically observed. In a paper published in the Philosophical Transactions for 1906 I gave the times of maxima of this period as being $1903 \cdot 72 + 4 \cdot 79\ n$. This would bring the maximum to 1908·51, or to about July 1 of the present year. A retardation of one month in a period of more than four years' duration is, of course, insignificant.

Simla, October 19. ARTHUR SCHUSTER.

Memory in the Germ Plasm.

DR. ARCHDALL REID repeats (NATURE, October 15, p. 605) his well-known opinion that from infancy forwards a man develops physically and mentally, principally under the stimulus of use, and he adds, "*the muscles of an infant's limbs do not grow unless used.* His mind is almost blank at birth, but grows under the influence of experience (use). In this way *he learns to coordinate his muscles*, and a vast deal more."

There are no italics in the original, but it is to these two statements that I desire to direct attention.

In regard to the first of them, we may well ask what evidence Dr. Reid can adduce for such a statement. It would be nothing but a vague and even false analogy if he relies upon what happens when limbs are paralysed owing to damage to the spinal cord. Physiologists generally would surely believe that the muscles of an infant tend to grow after birth, just as its bones tend to grow—those of the skull, for instance—quite irrespective of use, however much the process may in some cases be accelerated by use.

Then, again, there are crucial facts to show that in regard to many most complicated movements it is not necessary for a child to "learn to coordinate his muscles." On the contrary, the possibility of coordinating very many muscles, even for such very complex acts as speaking and walking, is brought about as a result of the inheritance of cell and fibre groupings in the brain and spinal cord which only become perfected after birth. It is true that for both these complex muscular acts it commonly happens that trials and failures are made while the nerve mechanisms are developing—hence children may seem to acquire these accomplishments solely as a result of experience. But the real all-important share of inheritance in bringing about the possibility of performing the complex muscular acts in question is conclusively shown by cases in which, from some cause, speech or the ability to walk is delayed to a comparatively late period—when the related nervous mechanisms have had time to become developed. Then, under the influence of some strong excitement, a child who has never spoken a word up to two or even five years (but whose sense of hearing is good) may suddenly begin to speak clearly without antecedent attempts of any kind. Cases of this sort may be found recorded in my work "Aphasia and other Speech Defects" (pp. 5–8).

The same kind of thing may occur in regard to walking. When mentioning the cases of untaught speech above referred to one day to the late Sir Richard Quain, he told me that one of his children, up to the age of two years, "had not walked a step, or even tried to walk, when one day he put her down in the standing position, and to his great surprise, as well as to that of the nurse, she walked from one side of the room to the other." This also was an untaught act, as there had been no previous trials and failures" ("Brain as an Organ of Mind," p. 607).

Thus, because insects and many other animals, as Dr. Reid says, "come into the world fully equipped physically and mentally to cope with their environment," and man does not, it does not at all follow that the inherited formative tendencies of man may not go on to a considerable extent after birth, even though use, in the majority of cases, does come in as a cooperating cause

while the necessary nerve mechanisms are developing. To ascribe so much to use, as Dr. Reid does, and so little to inheritance, is surely a grave error. Speech has certainly been acquired by the human race, and it is an accomplishment which is not learned afresh by each one of us as he would have us believe—we inherit the nervous mechanisms that make it possible, and these tend to develop even independently of use. H. CHARLTON BASTIAN.

The Athenæum, October 20.

I FEAR I must think that the crucial instances which Dr. Bastian mentions are merely cases in which the observer, having a preconceived theory, has preferred an improbable interpretation to an obvious and simple one. The muscles of the limbs atrophy when disused through joint disease as well as when the injury is in the spinal cord. At the same time the nails, which do not develop under the stimulus of use, continue to grow. It is always difficult to prove the excessively obvious in a few words; and to me—if anyone ever learns anything—children as obviously learn to walk and speak as to write and swim. Dr. Bastian would have us believe that people who have never heard a word would still be able to express their thoughts in language. But in what language? How does it happen that children always speak the language of the people with whom they are reared? My parents were English. My first language was Hindustani. Which of the two was innate? Structures (*e.g.* external ears), which do not develop under the stimulus of use, do not atrophy through disuse. So also instincts never atrophy—are never forgotten—through disuse. How does it happen that I have forgotten my first language?

G. ARCHDALL REID.

Netherby, Victoria Road, S., Southsea, October 27.

Polypus Vinegar—Sea-blubber Arrack.

(1) ALTHOUGH I am afraid it is now much too late to reply to Mrs. Hoskyns-Abrahall's inquiry anent the so-called *Polype vinaigre* (NATURE, August 9, 1906, vol. lxxiv., p. 351), to which hitherto no answer has appeared in your columns, I may be allowed to quote the following passage as a probably important clue to its scientific elucidation:—

"Amongst the greatest curiosities of the Yellow Sea there is a wonderful polypus, only recently discovered. This curious zoophyte is known on the coast of Newchwang by the name of *Chang-yu*, and possesses the property of turning into vinegar the fresh water in which it is placed. This fact was noticed for the first time in Huc's travels in China and Thibet, but our savants at home were rather sceptical on the point, and refused to believe in its existence till it was lately sent to Paris by another missionary, Mr. Pernys, and the specimens, one alive and one dead, being put in tank at the aquarium of the Société d'Acclimatisation, they both turned into vinegar the fresh water in which they were placed" (A. Fauvil, "The Province of Shantung," in the *China Review*, vol. ii., No. 6, 1875, pp. 366–7).

So far as my limited reading goes, not a single Chinese work mentions or describes this remarkable creature. But I may hazard a remark that peradventure by *polype* Huc really meant a cephalopod, for the "Pen-tsao" applies the name Chang-yü (not *yu*) to the octopus, which formed a member of the classic authors' Polypi, as is manifest in Pliny's "Natural History," bk. ix., ch. 48 (see also the "Encyc. Brit.," ninth edition, vol. xix., p. 428).

(2) In "A New Account of East India and Persia in Eight Letters, being Nine Years' Travels, begun 1672 and finished 1681," by Dr. John Fryer, F.R.S., published London, 1698, pp. 68–9, the writer, recounting the causes of the bad health of the inhabitants of Bombaim, an island situated sixty leagues south of Surat, and the same distance north of Goa, says, "Among the worst of these, Fool Rack (Brandy made of *Blubber*, or *Carvil*, by the Portugals, because it swims always in a blubber, as if there were nothing in it; but touch it, and it stings like nettles; the latter, because sailing on the Waves it bears up like a Portugal Carvil; it is, being taken, a Gelly, and distilled causes that take it to be Fools), and Foul Women may be reckoned."

It is well known that certain species of jelly-fishes are eaten with gusto by the Japanese and the Chinese, but we have never heard, except the above instance, of any acaleph capable of yielding a spirituous liquor. Will any of your readers kindly tell whether it is fiction or truth?

KUMAGUSU MINAKATA.

Tanabe, Kii, Japan, August 6.

Occurrence of a Fresh-water Nemertine in Ireland.

IN NATURE, 1902 (vol. xlvi., p. 611), Prof. Benham records the discovery of a fresh-water Nemertine living in the River Cherwell, at Oxford. He found only a single immature specimen, which was accidentally destroyed before the specific title was definitely determined. I have recently (October) obtained numerous sexually mature specimens of a Nemertine, living among weeds in the Grand Canal, at Clondalkin, co. Dublin.

Seven species of fresh-water Nemertines, all belonging to the genus Prostoma (Tetrastemma), are recognised by Bürger (*Tierreich*, vol. xx., p. 68). The distinctive characters are somewhat vague, and depend largely on differences in the mode of reproduction. The Irish forms are referable to the species ***Prostoma clepsinoides***, Ant. Dugès, with which the ***Tetrastemma aquarum dulcium*** of Silliman is probably synonymous. Benham notes several points in which his specimen differed from the latter species, and the Irish specimens show the same differences. Such points, however, as the relative position of the eye-spots and ciliated pits depend largely on the state of contraction of the worm, or it is possible that Silliman made his drawings from pressure preparations. As Benham points out, the proboscis is much longer than Silliman shows. Benham also says that the colour of his specimen was due to pigment in the skin, and not to the red colour of the nervous system. In the Irish worms, the epidermis is only faintly yellow in colour, whilst the brain and nerve cords are bright red, as is usual in the Nemertines.

This species was also found by Beddard ("Cambridge Natural History," vol. ii., p. 118) in one of the tanks in the Botanical Gardens, Regent's Park.

These are the only records of fresh-water Nemertines in the British Isles, and it is highly probable that they refer to the same species, for which the name ***Prostoma clepsinoides***, Ant. Dugès, has priority.

ROWLAND SOUTHERN.

Natural History Department, National Museum, Dublin, October 22.

Mercury Bubbles.

I SHOULD be glad to learn through the medium of your columns if any previous attempt has been made to produce mercury bubbles, and, if the attempt was successful, where was the result described? A few days ago, while in the act of purifying mercury by the common method of treatment with acid, and afterwards washing with a powerful stream of water, I was surprised to notice quite frequently several beautiful silvery spheres circulating on the surface of the wash-water. As to dimensions, many of these spheres were at least 22 mm. in diameter, and I estimated the thickness of the metallic film in one case to be 0·017 mm.

The bubbles seemed to be produced by the jet of water entangling air at the moment of striking the surface of the water in the containing vessel, and thus carrying the air into the body of the mercury, the rapid circulation of the wash-water helping to disengage the bubbles from the surface of the metal as they were formed. It is just possible that the air was not derived from the surrounding atmosphere, but was contained in the water supply. I should add that in my laboratory the pressure averages about 60 lb., and there is undoubtedly at times a relatively large amount of air present.

J. G. ERNEST WRIGHT.

South Benwell, near Newcastle-on-Tyne.

SOME CROMLECHS IN NORTH WALES.[1]

II.

BEFORE I refer to other matters I give a plan made by Mr. Neil Baynes, which he kindly permits me to use, of the cromlech at Ty Newydd. It shows well the kind of nut the archæologist has to crack when cromlechs are studied astronomically. It appears twice in Mr. Griffith's list. I made it out as oriented to the *winter* solstice rising, Mr. Baynes to the *summer* solstice rising. We took our angles along two surfaces of the same nearly rectangular supporter A; I nearly along the line of the quoit, he across it. I also give a copy of a photograph taken by my wife showing the clino-compass in the line of the outlook between the stones A and C. Either reading may be the correct one, but, be it remarked, *both are solstitial*, and no other astronomical alignment is suggested by the arrangement of the stones. It may be that the outlook was between the stones C and B, the direction being parallel to the south surface of A, and not as I placed it; on this view we are dealing with the summer solstice sunrise, and this may be accepted for the statistical statement.

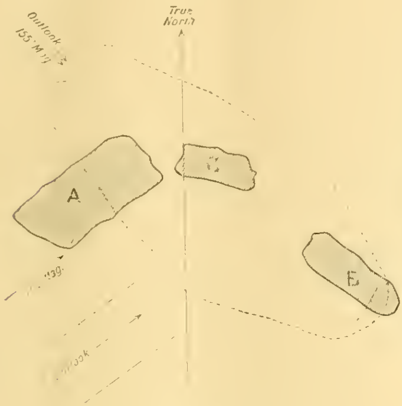


FIG. 6.—Plan of the Ty Newydd Cromlech.

With regard to the *distribution* of the sight-lines, the most abundant are the solstitial; summer solstice, 3, winter solstice, 4, total 7.

Next comes the May year, both May and November (3), and last of all the equinoxes (2). With regard to warning stars, two alignments to the Pleiades were noted; of cromlech alignments on a clock-star none was seen. There is one case at Lligwy of a clock-star alignment from an equinoctial cromlech. At Plas Newydd and Bryn Celli Ddu there were outlying stones to be further examined.

As the measures recorded by Mr. Griffith are the only ones available, we are compelled, if we wish to make comparisons with other temple-fields, to take them as fair samples of the distribution of the various alignments in the region under investigation, although the number of cromlechs included, fifteen, is doubtless only a small fraction of those which remain to be examined when the Welsh archæologists set to work.

The most remarkable fact is the total absence of circles and avenues in the region examined. In another cromlech region, Brittany, we have no circles, but a preponderance of avenues.

Next, the Cornish solar monuments deal chiefly with the May year. This is reversed in North Wales, where the solstitial year is mainly in question. In Brittany the avenues seem fairly divided between the May and solstitial years; touching the cromlechs there I have no information.

Another point is the absence of clock-star alignments. This, perhaps, may be associated with the absence of circles either of the Cornish or Aberdeen type. In Aberdeenshire we find a very large proportion of the alignments set out for observations of clock-stars. In Cornwall they are about as numerous as the solar alignments. Indeed, the great distinction between North Wales and Aberdeen lies, not only in the absence of cromlechs in Aberdeen, but in the large percentage of clock-star alignments as compared with solar alignments. There is an inversion.

I pointed out when discussing the Aberdeen results that the number of true north alignments, almost entirely absent in Cornwall, might indicate that clock-star work was being given up in consequence of a much better knowledge of astronomy rendering the observations of the *rising* of clock-stars unnecessary. The question is, does this consideration explain the very small attention to clock-stars in North Wales? If so, North Wales is later than Aberdeen. In true north alignments a cromlech could not be conveniently used, but, unfortunately, circles seem not to have entered into the North Wales building system, so that the question cannot be settled by statistics.

In Aberdeenshire the number of May-year and solstitial alignments measured was about the same, but I found reason for thinking that some May monuments had been tampered with. As these were not included in the tables, there was a slight preponderance to the solstitialists, but not so great as in Wales.

Photo. by Lady Lockyer.

FIG. 7.—The Ty Newydd Cromlech looking S.E.

There are many arguments which may be used to show that, as in Egypt, the solstitial year followed the May year, and, accepting them, there is a clear indication that the more prolific building period in North Wales was later than in Cornwall.

[1] Continued from vol. lxxviii., p. 635.

I have already given my opinion that the balance of the evidence is in favour of the view that the building period in Aberdeen was later than in Cornwall.

When more observations are available to compare the lateness of North Wales with that of Aberdeen, a question of great interest will be presented to the Welsh archæologists; but already it may be gathered from the preceding summary of the facts so far garnered that they are in harmony with the information handed down from Roman times.

Photo. by Lady Lockyer.
FIG. 8.—Ystym Cegid (Pleiades).

Cæsar does not locate the Druids,[1] except that there were none in Germany. But Tacitus only refers to them in Anglesey (Mona), "A common refuge for all the discontented Britons."[2] In his account of the attack upon the island (p. 30) he tells us:—"The Druids were ranged in order with hands uplifted, invoking the gods, and pouring forth horrible imprecations." He adds, "The religious groves, dedicated to superstitious and barbarous rites, were levelled to the ground."

I cannot help thinking that unless Anglesey were specially Druidical, Tacitus would have referred to Druidism in other parts of his history, and that the Roman writers refer to the occupation of Anglesey by the Druids in such a way as to suggest that they did not come across them in force anywhere else.

If a large number had taken refuge in Anglesey after they had been driven by one race or another from their former haunts elsewhere, we should expect their temple building to be such as we have found it, *i.e.* a few monuments of the most ancient type, showing that it was from the earliest times a druidical sanctuary, scattered among a larger number of comparatively modern provenance.

I now come to the method employed in laying out the cromlechs. In previous notes I have pointed out that it was to be gathered from the Cornish cromlechs that the actual direction of the completed structure was parallel to the principal face of one of the supporting uprights, and that probably this setting out of the alignment was the work of one possessing a greater knowledge than those who eventually completed the erection. This view has been entirely borne out by the Anglesey cromlechs; Pant y Saer is a good case in point; there are three stones parallel to the alignment, and two at right angles to it. The S.E. stone on Bryn Celli Ddu dominates the orientation of the creepway, as I have already stated.

In the case of some cromlechs which have been surveyed with great care by Mr. Baynes, and of which he has been good enough to send copies of the plans which have been published in the "Archæologia Cambrensis" or elsewhere, most extraordinary blunders in the direction of the north point have been brought to light. No wonder that the solstitial alignment of Bryn Celli Ddu was not recognised when its orientation on the plan was 35° out!

Although I have dealt with some of the general questions which have been raised by the observations made by Lord Boston, Mr. Baynes, the Rev. J. Griffith, and myself on the small number of North Wales cromlechs which we were able to measure in the limited time at our disposal, they are by no means exhausted. It may also be added that when the orientations of a much larger number have been recorded the general questions raised are certain to be increased.

It is worth while to point out again that all the orientations found in North Wales are identical with those already noted in Cornwall and elsewhere; by which, of course, I do not mean that the sight-lines are parallel, but that their object was the same; and no better proof of this could be afforded than by the facts that to secure the same object the differences of latitude, azimuth, and height of the horizon, when taken into account, give us the same declinations of the sun at the summer and winter solstices, and for the critical dates of the May year when the sun's declination is 16° 20′ N. and S.

Photo. by Lady Lockyer.
FIG. 9.—Pant y Saer (May Sunrise).

Work is also provided for the new Royal Commissioners who, I am delighted to learn, have now been appointed to study the few remnants of the ancient monuments of England, Wales, and Scotland which still remain to us, in spite of the ignorance and carelessness of successive governments and owners.

[1] "Bello Gallico," vi., 13–14, 16 21.
[2] Annals, xiv., 29. Murphy's Translation. (Dent and Co.).

Before the astronomical study of them was commenced a very few years ago, if we accepted the available records the cromlechs were all directed helter-skelter, their sight-lines were without any meaning, and no astronomical or practical use was served by them, except, perhaps, as tombs. A comparatively few observations have sufficed to show the absurd inaccuracy of these views; for full light we may be content to wait for the authoritative inquiries now happily commenced. That our knowledge will be largely increased in many directions there is no room to doubt.

NORMAN LOCKYER.

NIAGARA AS A GEOLOGICAL CHRONOMETER.

THE use of Niagara as a geological chronometer dates from the visit there of Lyell in 1835. He recognised that the Falls must date from the close of the Glacial period, and that the Niagara gorge must have been excavated since the retreat of the glaciers from the Great Lakes. The necessary assumptions as to uniformity of rate and condition being granted, he held that the length of the gorge divided by the amount which the Falls recede up-stream annually would give the length of post-Glacial times for the Niagara district in years. He realised the uncertainty of some of the data, but estimated that the age of the Falls is about 35,000 years. The problem, however, is not to be solved by simple rule of three, for the data are complex, and there are many variable factors. Lyell himself used one of the unknown elements to explain the formation of the Niagara Whirlpool. He rightly attributed it to the existence of a channel filled with drifts, which are now worn away more quickly by the river than the rocks of the old river banks; and if part of the existing gorge had been formed by the re-excavation of a channel filled with drift, the process would have been much quicker than if the Falls had to cut their way for the whole distance through the hard Niagara limestone. Lyell's estimate has therefore been greatly reduced by some later geologists, and Dr. G. K. Gilbert has allowed the Niagara Falls a life of only some 7000 years, with a possibility of even considerably less

The last contribution to the Niagara question is a monograph by Dr. J. W. W. Spencer, published by the Canadian Geological Survey.[1] It makes two important additions to the known facts. A series of borings has been made to determine the course of the former river channel which is exposed at the Niagara Whirlpool, and the Niagara River below the Falls has been carefully sounded. The soundings have proved the existence of a basin 192 feet deep immediately below the Falls; the river then shallows, until at the Cantilever Bridge the depth is only 86 feet. The basin is due to the filling up of the channel by material that has fallen in from the sides of the gorge after the Falls have passed up-stream, a fact proved by work undertaken in connection with the foundations of the bridge.

Dr. Spencer, in addition to these important contributions to the facts, has carefully re-discussed the evidence and shown how complicated the problem is, owing to the numerous post-Glacial changes in the physical geography of the Niagara area during the lifetime of the Falls. According to his calculations, the Falls have receded up-stream at a mean rate of 4·2 feet per annum, during the sixty-three years between 1842 and 1905. The rate of retreat is not uniform, for the process consists in the cutting of a V-shaped groove, which is gradually widened during a period when there is no recession of the notch; the edge of the Falls thus becomes straighter, and then the formation of the horse-shoe curve begins again. By the double process $7\frac{3}{4}$ acres of the river bed above the Falls have been removed since 1842.

[1] "The Falls of Niagara: their Evolution and Varying Relations to the Great Lakes; Characteristics of the Power and the Effects of its Diversion." (Ottawa: Geol. Survey of Canada, 1907.) Pp. xxxi+490; plates and maps.

The precise measurements of the recession of the Falls in recent years have been accompanied by increasing recognition of the extreme complexity of the problem. The existing river system connected with the Great Lakes necessarily dates from the close of the Glacial period in that area; for it was not until the ice had disappeared that rivers could be formed, and many of them had their sources in the extensive glacial lakes along the receding ice-front. The course of these rivers altered as the lake levels were lowered, and also in consequence of earth-movements, possibly due to the removal of the ice-load.

When the waters of Niagara first fell from the plateau into the basin of Lake Ontario they had a fall of only 35 feet, for the lake then stood at the level of some of its uppermost beaches, and the river discharged directly into the lake. The power of the Falls was then comparatively small, for they had only 20 per cent. of their present height, and only 15 per cent. of the present volume. For the Niagara River was then fed only by the overflow from a comparatively diminutive lake in the lowest depression on the plains now covered by Lake Erie. The drainage from the Great Lakes, instead of passing through Lake Erie into the Niagara River, was collected into Lake Huron, and was discharged through the gap containing Lake Nipissing to the valley of the Ottawa River.

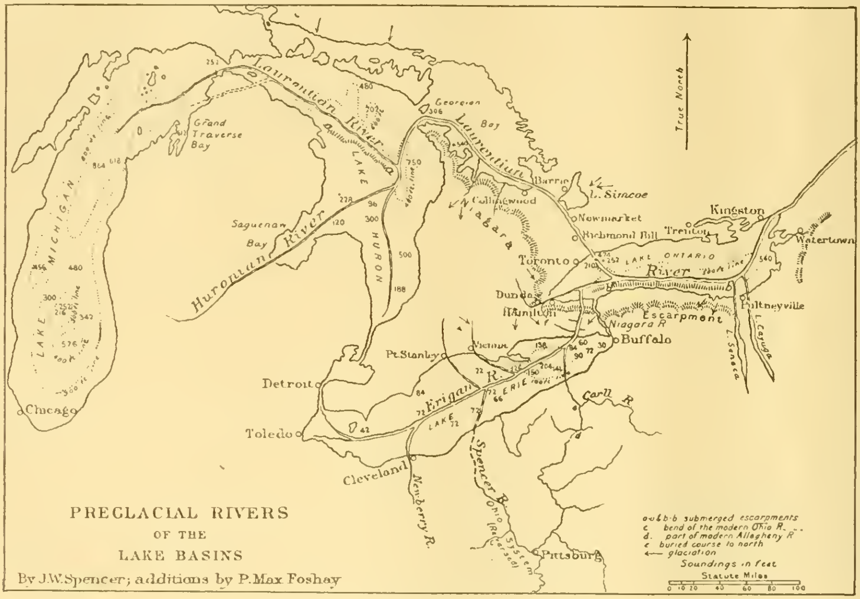
This arrangement was disturbed by the subsidence of the country to the north-east of Lake Ontario, whereby the level of that lake was lowered, and the outlet from Lake Huron to the Ottawa River closed. A fresh channel was opened from the southern end of Lake Huron through a valley now filled up with drift into Lake Ontario. Further movements led to the closing of this outlet, and the waters of Lake Huron flooded the valleys of the southern tributaries and the area that is now Lake St. Clair. The level of the lake rose until it found an outlet at the head of the Detroit River into Lake Erie, and thus at length Niagara received the overflow from the Great Lakes.

A further complication is introduced by the fact that for one period the Great Lakes had an escape southward from Lake Michigan, near Chicago, into the Mississippi; but this outlet appears to have existed for a comparatively short time.

The value of Niagara as a geological clock is therefore open to grave suspicion, for the erosive power of the Falls must have varied enormously, both with the varying resistance of the rocks and with the varying volume of the Niagara River and height of its Falls. Nevertheless, Dr. Spencer is delightfully confident of the exact accuracy of his conclusions. "The work of the Falls of Niagara along its whole course has now been made known," and the author claims that his work has brought the dates of the various geographical episodes at Niagara out of the realm of speculation. He rejects the shorter estimates of the length of the Niagara Falls, and somewhat exceeds the result adopted by Lyell, for he assigns them an age of 39,000 years. He also claims to have determined in years the date of the chief episodes in the life-history of the Falls. According to Dr. Spencer, the overflow from Lake Michigan to the Mississippi occurred from 2000 to 2500 years ago; the Falls were at the Whirlpool 3000 years ago, and the capture of the discharge from the Great Lakes by the Niagara River happened 3500 years ago.

The future of the Great Lakes and of Niagara is threatened by two dangers. The diversion of water

by the electric power companies has already reduced their beauty, and if the existing projects are carried into effect the American Fall will be reduced to a few threads of water and the Canadian Fall rendered comparatively insignificant. The second danger is the possible tilting of the area of the Great Lakes, which would, at the rate of movement estimated by Dr. G. K. Gilbert, bring Niagara to a close in about 3500 or 5000 years. This theory is of great interest, as it has been generally advanced as the best established case of a still progressing uplift of a large area of the earth's crust. Dr. Spencer, however, rejects this conclusion, and though he lays great stress on recent earth-movements in the region to the north-east of the Great Lakes, he claims that the lake region itself has been quite stable, and that no earth-movements are now taking place there. The facts advanced to prove the supposed uplift he holds can be explained by seasonal and meteorological changes.



Map of the Pre-Glacial Valleys of the Great Lake Region

The Geological Survey of Canada is to be congratulated on this interesting, well illustrated, and important memoir. Its value renders all the more regrettable the inclusion of a series of personal charges against one of the most respected of American geologists, which are quite out of place in an official publication.

J. W. GREGORY.

THE NATURE AND CHARGE OF THE α PARTICLES FROM RADIO-ACTIVE SUBSTANCES.

THE development of our knowledge of radio-activity has emphasised the primary importance of the α particles, which are projected in great numbers from most of the active substances. As Rutherford showed in 1903, the α particles are veritable atoms of matter which are ejected from radio-active matter at a speed of about 10,000 miles per second. The great number of α particles which are projected from radium is well illustrated by the multitude of scintillations observed when the α particles from a trace of radium fall on a screen of zinc sulphide. We shall see later that 136 million α particles are expelled every second from one milligram of radium in radio-active equilibrium. From the point of view of modern theory, the appearance of an α particle is the sign of a violent atomic explosion in which a fragment of the atom—an α particle—is ejected at a high speed. In the majority of the known active substances, the expulsion of an α particle accompanies the transformation of one substance into another, and the decrease of atomic mass consequent upon the loss of an α particle at once offers a reasonable explanation of the appearance of an entirely new kind of matter in place of the old.

Space does not allow us here to discuss the very interesting facts that have been brought to light by the work of Bragg and Kleeman and others in regard to the character of the absorption of the α particle by matter. It suffices to say that it has been found that the α particles from one kind of active matter are all projected initially at an identical speed, but that this initial velocity varies within comparatively narrow limits for different kinds of matter. The α particle, in consequence of its great energy of motion, plunges through the molecules of matter in its path, leaving in its train a large number of dissociated or ionised molecules. Some important questions at once arose when it was found that the α particle was an atom of matter of mass comparable with the hydrogen atom, viz., Are the α particles expelled from different kinds of matter identical in constitu-

tion, and are the α particles atoms of a known element or some new kind of matter?

These problems were attacked by determining the velocity and the value of E/M—the ratio of the charge carried by an α particle to its mass—of α particles expelled from different kinds of matter. These quantities can be determined by measuring the deflection of a pencil of α rays when passing through strong magnetic and electric fields. Experiments of this kind, which are difficult on account of the small deflection of the α rays under normal experimental conditions, have been made by Rutherford, Des Coudres, Mackenzie, and Huff. The former determined the velocity and value of E/M for each of a number of products of radium and actinium, while Rutherford and Hahn made similar measurements for some of the products of thorium. The results were of great interest, for while it was found that the initial velocity of projection of the α particles from different kinds of matter varied from about 14,000 to 10,000 miles per second, the value of E/M was the same for all. This shows that the α particle, whether expelled from radium, thorium, or actinium, is identical in mass and constitution, and that all the radio-active substances which emit α particles have a common product of disintegration. As the result of a number of experiments, Rutherford found that the value E/M for the α particle was 5070 in electromagnetic units. Now, from experiments on the electrolysis of water, it is known that the corresponding value of e/m for the hydrogen atom is 9600, or nearly twice as large. The charge e carried by the H atom is believed to be the fundamental unit charge of electricity, so that the charge carried by any body must be an integral multiple of e. If we suppose the charge carried by an α particle is equal to the charge carried by an hydrogen atom, the mass of the α particle is, in round numbers, twice that of the hydrogen atom, *i.e.* is equal to the molecule of hydrogen. If, however, we suppose that $E=2e$, *i.e.* the α particle carries two unit charges, the mass of the α particle is equal to about four. Now, it is known that the atomic mass of helium is 3·96 in terms of hydrogen, so that on this supposition the α particle would appear to be an atom of helium carrying two unit charges. We must now consider some indirect evidence bearing on the question. As the result of the experiments of Ramsay and Soddy and others, it is now well substantiated that helium is produced from radium. Debierne has shown that helium is produced also from actinium. Unless the helium is the result of the accumulated α particles, it is difficult to account for the production of the helium observed. In addition, as we have shown, the α particle is the only known common product of the disintegration of radium and actinium, which both give rise to helium. For these and other reasons, Rutherford suggested in 1905 that it was very probable that the α particle was an atom of helium carrying two unit charges. It has been found exceedingly difficult experimentally either to prove or disprove the correctness of this hypothesis, although the settlement of this question has been for the last few years the most important problem in radioactivity, for, as will be seen, the proof that the α particle is an atom of helium carries numerous consequences of the first importance in its train.

We shall now describe some novel experiments by Rutherford and H. Geiger, which have not only thrown further light on this question, but have led to important conclusions in several directions. An account of this work is contained in two papers published in the Proceedings of the Royal Society, entitled "An Electrical Method of Counting the α Particles from Radio-active Matter," and "The Charge and Nature of the α Particle" (A. vol. lxxxi., 141–174, 1908).

In the first paper an account is given of a method for the detection of a single α particle and for counting the number of α particles emitted from one gram of radium.

The current due to the ionisation of the gas produced by a single α particle is too small to detect except by exceedingly refined methods. To overcome this difficulty, recourse was had to a method of automatic magnification of this current, based on the principle of generation of ions by collision—a subject which has been investigated in detail by Townsend and others. Space does not allow us to enter into a description of the methods employed for this purpose or of the various experimental difficulties that arose during the investigation. The general method employed was to allow the α particles to be fired through a small opening into a detecting vessel containing gas at low pressure exposed to an electric field not far from the sparking value. The entrance of an α particle into the detecting vessel was marked by a sudden ballistic throw of the electrometer needle. By adjustment of the electric field, it was found possible to obtain so large a magnification that the entrance of a single α particle was marked by a large excursion of the electrometer needle.

In this way the expulsion of α particles was detected from uranium, thorium, radium, and actinium. In order to count accurately the number of α particles expelled from one gram of radium, not radium itself, but its product radium C was used as a source of radiation. A surface was coated with a thin film of radium C by its exposure for some hours in the presence of the radium emanation. The use of radium C as a source of rays had several advantages, especially as regards the ease and certainty of measurement of the amount of active matter present by means of the γ rays. The number of α particles passing through an opening of known area at a known distance from the active source was counted for a definite interval by noting the excursions of the electrometer needle. From this the total number of α particles expelled per second from the source was deduced. In this way it was found that $3{\cdot}4\times10^{10}$ α particles were expelled per second from the radium C present in one gram of radium in equilibrium. It is known from other data that radium itself and each of its products, viz. the emanation, radium A and radium C, expel the same number of α particles per second when in equilibrium. Consequently in one gram of radium in equilibrium $3{\cdot}4\times10^{10}$ α particles are expelled from each of the products per second, and the total number expelled is $1{\cdot}36\times10^{11}$ per second. On the most probable assumption, that one atom of radium in breaking up emits one α particle, $3{\cdot}4\times10^{10}$ atoms of radium break up per second per gram.

It was a matter of interest to compare the number of scintillations observed on a properly prepared screen of zinc sulphide with the number of α particles striking it. Within the limit of experimental error, it was found that the number of scintillations was equal to the number of impinging α particles counted by the electric method. Consequently each α particle on striking the screen produces a scintillation. It is thus obvious that, using proper screens, the scintillation method as well as the electric method may be employed to count the number of α particles emitted by a radio-active substance.

Apart from the importance of these results for radio-active data, the experiments are of themselves noteworthy, for it is the first time that it has been found possible to detect a single atom of matter.

This, as we have seen, can be done in two ways, one electrical and the other optical. The possibility of detection of a single atom of matter is in this case, of course, due to the great energy of motion of the α particle.

In the second paper, an account is given of experiments to measure the charge carried by the α particles. Since the number of α particles is known from the counting experiments, the charge on each α particle can be determined by measuring the charge carried by the α particles expelled from a known quantity of radium. As in the counting experiments, radium C was used as a source of rays. It was found that each α particle carried a positive charge of $9{\cdot}3 \times 10^{-10}$ electrostatic units. Now the charge carried by an ion in gases has been determined by several observers, using the well-known method of making each ion the nucleus of a visible drop of water by a sudden expansion. J. J. Thomson obtained a value $3{\cdot}4 \times 10^{-10}$, H. A. Wilson $3{\cdot}1 \times 10^{-10}$, and Millikan and Begeman $4{\cdot}06 \times 10^{-10}$.

The mean of these three determinations of e is $3{\cdot}5 \times 10^{-10}$. The charge E on an α particle on this data thus lies between $2e$ and $3e$.

Some calculations of the value of E and e are then made from radio-active data based on simple and very probable assumptions. Taking the half-period of transformation of radium as 2000 years—the value found by direct measurement by Boltwood—it is shown, on the assumption that each atom of radium in breaking up emits one α particle, that the charge e carried by a hydrogen atom comes out to be $4{\cdot}1 \times 10^{-10}$. Similarly, supposing that the heating effect of radium is a measure of the kinetic energy of the α particles, the charge carried by an α particle comes out at $9{\cdot}1 \times 10^{-10}$—a value close to that found experimentally. A discussion is then given of the methods employed in the previous determination of e, and it is shown that in consequence of certain sources of error which are very difficult to eliminate, the values previously obtained tend to be too small. It is concluded that the unit charge e is not very different from E/2 or $4{\cdot}65 \times 10^{-10}$, and that an α particle carries twice the unit charge. From the previous discussion of the interpretation of the value of E/M for the α particle, it follows that an α particle must be an atom of helium carrying a double charge, or, in other words, that an α particle when its charge is neutralised is a helium atom.

It seems at first sight contradictory that an atom of a monatomic gas like helium can carry two unit charges. It must be borne in mind that in this case the α particle plunges at a great speed through the molecules of matter, and must itself be ionised by collision. If two electrons can be removed by this process, the double positive charge is at once explained.

We thus see that by a direct method we have been enabled to count the number of α particles and to determine the charge caused by each, and from other evidence to deduce that the unit charge e is half the charge carried by the α particle.

With the aid of this data we can at once deduce the magnitudes of some important atomic quantities. The value of e/m for the hydrogen atom is $2{\cdot}88 \times 10^{14}$ electrostatic units. Substituting the value of $e = 4{\cdot}65 \times 10^{-10}$, it follows that the mass of a hydrogen atom is $1{\cdot}61 \times 10^{-24}$ gram. From this it follows that there are $6{\cdot}2 \times 10^{23}$ atoms in one gram of hydrogen, and that there are $2{\cdot}72 \times 10^{19}$ molecules in a cubic centimetre of any gas at standard pressure and temperature.

From the data already given we can predetermine the magnitude of some important radio-active quantities. Let us first consider the rate of production of helium by radium. One gram of radium in equilibrium contains four α-ray products, each of which expels $3{\cdot}4 \times 10^{10}$ α particles, *i.e.* atoms of helium, per second. Consequently, since there are $2{\cdot}72 \times 10^{19}$ atoms of helium in a cubic centimetre, the volume of helium produced per second is $\frac{4 \times 3{\cdot}4 \times 10^{10}}{2{\cdot}72 \times 10^{19}}$, or $5{\cdot}0 \times 10^{-6}$ c.mm. per second. This corresponds to a production of helium of 0·43 c.mm. per day, or 158 c.mm. per year.

In a similar way, the maximum volume of the emanation in one gram of radium can be calculated. Since one atom of radium in breaking up emits one α particle and gives rise to one atom of emanation, the volume of emanation produced per second is one-quarter the volume of helium, or $1{\cdot}25 \times 10^{-6}$ c.mm. per second. Since the average life of the emanation is 468,000 seconds, the maximum volume of the emanation comes out to be 0·585 c.mm. In a recent paper Rutherford (*Phil. Mag.*, August) has measured the volume of the emanation and obtained a value not very different from the calculated volume. In a similar way, it is not difficult to calculate the period of transformation of radium and the heating effect of radium. The former comes out at 1750 years, which is somewhat shorter than the value 2000 years found experimentally by Boltwood. As Boltwood points out, however, the probable experimental errors are such as to tend to give too high a value for the period. The latter is deduced on the hypothesis that the heating effect is a measure of the kinetic energy of the expelled α particles. The heating effect is calculated to be about 113 gram calories per gram per hour, while the observed heating effect of the sample of radium from which the standard preparation was taken was found to be 110 gram calories per hour. For convenience, the data obtained in this paper are collected below:—

Charge carried by a hydrogen atom	$= 4{\cdot}65 \times 10^{-10}$ electrostatic units.
Charge carried by α particle	$= 9{\cdot}3 \times 10^{-10}$ electrostatic units.
Mass of H atom	$= 1{\cdot}61 \times 10^{-24}$ gram.
Number of atoms per gram of H	$= 6{\cdot}2 \times 10^{23}$
Number of molecules per c.c. of any gas at standard pressure and temperature ...	$= 2{\cdot}72 \times 10^{19}$
Number of α particles expelled per sec. per gram of radium itself	$= 3{\cdot}4 \times 10^{10}$
Number of atoms breaking up per sec. per gram of radium	$= 3{\cdot}4 \times 10^{10}$
Calculated volume of emanation per gram of radium	$= 0{\cdot}585$ c.mm.
Production of helium per gram of radium per year	$= 158$ c.mm.
Calculated heating effect of radium per gram ...	$= 113$ gr. cal. per hour.
Calculated period of radium ..	$= 1750$ years.

We have already seen that there is a substantial agreement between the calculated values of the heating effect, the life of radium and the volume of the emanation, and the experimentally determined values. A still further test would lie in a comparison of the calculated and observed rates of production of helium by radium. Data on this subject will probably soon be forthcoming.[1]

Some very important consequences follow from the proof that the α particle is a helium atom. It must be concluded that the atoms of the known radio-active elements are in part at least constituted of helium atoms which are liberated at definite stages during

[1] (Footnote, added September 12, 1908.) In a paper just to hand (Proc. Roy. Soc., A., vol. lxxxi., p. 280) Sir James Dewar has shown experimentally that 0·37 c.mm. of helium is produced per gram of radium per day. This is in excellent agreement with the calculated rate, 0·43 c.mm. per day.

the disintegration. It will be seen that in many cases the atomic weights of the various products can be deduced. In the succession of products produced by the disintegration of the uranium-radium series, there occur several rayless products and β-ray products. Assuming, as is not improbable, that the atomic products undergo an internal rearrangement without the expulsion of a mass comparable with the hydrogen atom, we can calculate the atomic weights of the successive products, taking the atomic weight of helium as 4. From the known range of the α particles from uranium and the ionisation it produces compared with the radium associated with it, there is no doubt that uranium expels two α particles to one from radium itself. Whether this is a peculiarity of uranium itself or due to an unseparated product in uranium is not settled.

Taking the atomic weight of uranium as 238·5, the atomic weights of the different products are as follows:—Uranium X 230·5, ionium 230·5, radium 226·5, emanation 222·5, radium A 218·5, radium B 218·5, radium C 214·5, radium D, E, and F (radio-lead) 210·5, radium A (polonium) 210·5. It will be seen that the calculated value of the atomic weight of radium is in good agreement with the most recent experimental values. The end product of radium after the transformation of polonium has an atomic weight of 206·5—a value close to that of lead (206·9). Boltwood long ago suggested, from examination of the amount of lead in old radio-active minerals, that lead was the probable final product of the disintegration of the uranium-radium series.

We cannot at the moment apply the same method of calculation to thorium products, for Bronson (*Phil. Mag.*, August, 1908) has recently brought strong evidence that the disintegration of the atoms of some of the products is accompanied by the expulsion of more than one α particle.

In conclusion, it may be of interest to note that the experimental results recorded in this article lead to an experimental proof—if proof be needed—of the correctness of the atomic hypothesis with reference to the discrete structure of matter. The number of α particles expelled from radium can be directly counted, and the corresponding volume of helium determined. In this way it is possible to determine directly the number of atoms in a cubic centimetre of helium quite independently of any measurements of the charge carried by the α particles.

E. RUTHERFORD.

NOTES.

THE following is a list of the fellows recommended by the president and council of the Royal Society for election into the council for the year 1908–9:—*President*, Sir Archibald Geikie, K.C.B.; *treasurer*, Dr. Alfred Bray Kempe; *secretaries*, Prof. Joseph Larmor, Prof. John Rose Bradford; *foreign secretary*, Sir William Crookes; *other members of council*, Sir George Howard Darwin, K.C.B., Prof. J. C. Ewart, Sir David Gill, K.C.B., Dr. J. S. Haldane, Mr. C. T. Heycock, Prof. Horace Lamb, Prof. H. M. Macdonald, Dr. F. W. Mott, Hon. C. A. Parsons, C.B., Prof. W. H. Perkin, Prof. E. B. Poulton, Lieut.-Colonel D. Prain, Sir Arthur W. Rücker, Right Hon. Sir James Stirling, Prof. F. T. Trouton, Mr. W. Whitaker.

THE Royal Society's medals have this year been adjudicated by the president and council as follows:—The Copley medal to Dr. Alfred Russel Wallace, in recognition of the great value of his numerous contributions to natural history, and of the part he took in working out the theory of the origin of species by natural selection; the Rumford medal to Prof. H. A. Lorentz, for his investigations in optical and electrical science; a Royal medal to Prof. John Milne, for his preeminent services in the modern development of seismological science; a Royal medal to Dr. Henry Head, for his researches on the relations between the visceral and somatic nerves and on the functions of the afferent nerves; the Davy medal to Prof. W. A. Tilden, for his discoveries in chemistry, especially on the terpenes and on atomic heats; the Darwin medal to Prof. August Weismann, for his eminent services in support of the doctrine of evolution by means of natural selection; the Hughes medal to Prof. Eugen Goldstein, for his discoveries on the nature of electric discharge in rarefied gases.

M. PHILIPPE VAN TIEGHEM has been elected the permanent secretary of the Paris Academy of Sciences in succession to the late M. Becquerel.

THE International Congress of Geology will be held at Stockholm in 1910, when it is expected that Baron Gérard de Geer will, on his return from the Arctic regions, read a paper on polar geology.

A DEPUTATION from the Incorporated Society for the Destruction of Vermin waited upon Lord Carrington at the offices of the Board of Agriculture on October 29 to request the Government to appoint a commission to inquire into the damage to crops done by rats.

AN agreement has been signed by which England and Germany undertake to cooperate in combating the sleeping sickness in their East African possessions. The cooperation will take the form chiefly of exchanging reports of cases, and in arranging for the destruction of wild animals which act as "reservoirs," or provide nourishment, for the trypanosomes of sleeping sickness.

A COURSE of twelve lectures—the Swiney lectures on geology—on the geological history of the American fauna will be delivered by Dr. R. F. Scharff in the lecture theatre of the Victoria and Albert Museum, South Kensington, on Mondays, Wednesdays, and Fridays at 5 p.m. The first lecture was given on Monday last, November 2. Admission to the course is free.

WE learn through the *British Medical Journal* that Prof. Ehlers, of Copenhagen, well known as an authority on leprosy, is now in Paris with the view of organising a scientific expedition to the Danish West Indies, which comprise the islands of St. Thomas, St. John, and Santa Cruz. The object of the expedition is said to be to endeavour to determine the part played by blood-sucking insects, especially fleas and bugs, in the dissemination of leprosy.

THE Bisset Hawkins gold medal of the Royal College of Physicians has been awarded to Sir Shirley Murphy, medical officer of health of the County of London, for his distinguished services in the cause of public health. The FitzPatrick lectures of the college will be delivered on November 5 and 10 by Dr. Leonard Guthrie, on "The History of Neurology," and the Horace Dobell lecture by Mr. Leonard Dudgeon, on November 12, on "The Latent Persistence and the Reactivation of Pathogenic Bacteria in the Body."

ON October 30 Mr. Farman flew, with a machine heavier than air, seventeen miles across country in twenty minutes, from Châlons to a point just outside Rheims. The height of the course of flight was about 150 feet. On October 31 M. Blériot made flights across country from his station near Chartres, the longest being one of

nine miles in fourteen minutes. At Anvours on the same day Mr. Wilbur Wright made a flight of 10m. 37s. with a passenger. The new dirigible balloon, the *Clément-Bayard*, navigated by M. Henry Kapferer, on November 1 travelled a distance of about 200 kilometres, from Paris to Compiègne and back.

THE death is announced, at the age of forty-six, of Dr. F. A. C. Perrine, one of the leading American authorities on electrical engineering, and from 1893 to 1900 professor of that subject in the Leland Standford, Jr., University. He was afterwards consulting expert of the Standard Electric Company of California, which took the principal part in generating electrical energy at the mountain streams and transmitting it to the great cities of the Pacific coast. Of late years he was engaged in private practice as a consulting engineer. He was formerly editor of the San Francisco *Journal of Electricity* and of the Chicago *Electric Engineering*.

THE terms of reference have now been published of the Royal Commission appointed "to make an inventory of the Ancient and Historical Monuments and Constructions connected with or illustrative of the contemporary culture, civilisation, and conditions of life of the people in England, excluding Monmouthshire, from the earliest times to the year 1700, and to specify those which seem most worthy of preservation." The commissioners are authorised to call in the aid and cooperation of owners of ancient monuments, and are given full power to call before them such persons as are likely to afford any information upon the subject of the commission, and also to call for, have access to, and examine all such books, documents, registers, and records as may afford the fullest information on the subject. They are also empowered to visit and inspect personally such places as may be deemed expedient to inspect for the more effectual carrying out of the purposes of the inquiry.

A GENERAL meeting of the British Academy was held on October 28, when Dr. J. P. Postgate read a paper on flaws in modern classical research. In spite of the advances made and the results obtained in the field of classical research during the last sixty years, the outer world, he said, is still prone to doubt whether these are as great in proportion as those of other studies which claim to be scientific, or really commensurate to the time and energy expended upon them. The qualifications for any scientific research are competence and impartiality. Impartiality must be understood in a sense wide enough to include freedom from every prepossession which is likely to interfere with the proper weighing of the evidence. The first and generally neglected duty of the classical inquirer is the elimination of the personal equation. One of many disturbing elements found in every inquirer is the influence of modern forms of thought. The modern's comprehension of the facts is frequently impaired by the ethical judgments which he passes upon their character. A fertile source of error is the strength of modern vanity. We are the "heirs of all the ages," and the testimony of ancient witnesses is liable to be rejected summarily if either (*a*) we cannot reconcile it with what we deem we know otherwise, or (*b*) if it conflicts with evidence which we have had a hand in discovering. The procedure, especially in the less settled studies, such as archæology and mythology, is often too lax. Impressions gathered in one field are carried over to another where they do not apply. Owing partly to the vastness of the regions to be investigated, the conclusions of one band of inquirers are apt to be rejected by those in another sphere without proper consideration. In contrast to the true scientific spirit, which regards nothing as of no importance, inaccuracy in "minor" matters is condoned or even paraded, to the injury of fine scholarship and vivid appreciation of antiquity.

IN his presidential address to the Institution of Civil Engineers on November 3, Mr. J. C. Inglis dealt chiefly with engineering in relation to transport. In the course of his remarks he said it is only now dimly dawning in controlling quarters that there is a science of transport, and the fact that while British railways cost more than 50,000*l*. per mile, lines in Germany cost only about 20,000*l*., in France 27,000*l*., in America 11,000*l*., and so on, is symptomatic only of the extent to which British legislation, when it is allowed to proceed on unsound lines, may prejudice vital interests. Mr. Inglis referred also to the work done by the institution in improving the status and efficiency of engineers. He holds that it ought to be laid down as a principle that all public money derived from rates and taxes should be, so far as it is applied in engineering constructions, expended under the direction or control of definitely qualified engineers, as is already the case in many countries. The establishment of such a principle would promote efficiency and economy in much public expenditure, and would immensely strengthen the profession, as well as benefit the State. The difference between British and German ideals was expressed recently by a German professor lecturing on economic subjects in words quoted by Mr. Inglis as follows:—"The aim of the German was everywhere to leave as little as possible to chance in the great struggle of the twentieth century, not to allow people to muddle through somehow, but to eliminate as far as possible the element of the unforeseen, while carefully training the mind to cope if necessary in an intelligent way with any emergency. While the British had, as a rule, a violent suspicion of the expert, and a strong belief in the untrained, unpaid amateur as the right source of wisdom, allowing the expert to advise and the amateur to decide, the German had no fear of the expert. He well saw the possible danger of red-tapeism at the hands of highly trained officials, but he found them less than the dangers arising from the decisions of well-meaning but untrained and inexperienced amateurs."

MR. A. R. BUTTERWORTH, chairman of the executive committee of the Highways Protection League, has issued a circular letter in which he gives statistics to show (1) the number of local authorities which desire to have the present speed-limit of motor traffic reduced, and to have power themselves to fix still lower limits of speed in towns and villages in their own districts without having to make application to the Local Government Board; (2) the great increase in the number of persons annually injured and killed by motor vehicles. It appears that in 1905 197 urban and rural district councils of England and Wales approved of a proposal to reduce the maximum speed-limit to fifteen miles an hour, and 212 desired to have power to fix lower limits of speed in towns and villages and at any places where they thought it desirable to do so in the public interest. Up to October 19, 102 applications have been made by local authorities to the Local Government Board to reduce the speed-limit on certain roads; of these, only twenty-two have been granted, while eighty have failed. With regard to accidents attributable to motor traffic, at the present moment there are no complete reports obtainable of such accidents occurring throughout the country generally, but

the subjoined table, compiled from figures annexed to the recent report of the Commissioner of Police, shows the increase in the Metropolitan Police District, which embraces an area of 700 square miles:—

Accidents causing Death or Injury in the Streets within the Metropolitan Police District, 1897 to 1907 inclusive.

	Deaths		Injuries	
	Killed by motors	Killed by other vehicles or by horses	Injured by motors	Injured by other vehicles or by horses
Annual average for the five years 1897–1901	1·4	175	78	9,338
1902	6	169	319	9,186
1903	6	148	592	9,610
1904	22	133	1,112	9,272
1905	35	137	1,557	10,131
1906	74	138	3,358	10,702
1907	123	160	5,362	11,410

These figures make it very clear that not long after the Act of 1903 came into operation—on January 1, 1904—raising the maximum speed-limit from twelve miles an hour to twenty, the casualties caused by motor traffic increased rapidly. Injuries caused by non-motor traffic have also increased greatly in the last five years.

NOVEMBER has opened with the same fine and brilliant weather which characterised October, except that, in keeping with the season, there has been a decided fall of temperature, although the thermometer both by day and night remains several degrees above the average. The mean maximum temperature in London for October was about 6° above the average, and at Greenwich there were six days with the sheltered thermometer above 70°, and twenty-two days with the reading above 60°, whilst on October 3 and 29 the temperature exceeded all previous records, on the corresponding days, by 3°. The duration of bright sunshine was generally in excess of the average over the country, and in London the sun shone for ninety-eight hours, which is thirty hours more than the average. The aggregate rainfall for the month varied considerably in different parts of the kingdom, but there was generally a deficiency; the early part of the month was mostly very dry, but fairly heavy rains were general towards the close of October. In London there was a deficiency of rain amounting to 0·8 inch, the measurement being 1·9 inches.

THE Allahabad *Pioneer* published recently a further account of the explorations of Dr. M. A. Stein, written from Khotan in July last. In September, 1907, he commenced his long journey to the Tarim Basin for his second winter archæological campaign. He reached Karashahr, on the border of this region, in December, and at Korla made a fresh investigation of a group of Buddhist shrines, which had already been examined by Prof. Grünwedel. Many fine painted panels and relieves were unearthed here. The country, once irrigated from the Karakash River, must in former times have supported a large and thriving population, and even now, if the channels were restored, these settlements might be re-established. About Christmas the cold of the valley drove the party to the sunnier hill country. After returning to Korla he marched from the Inchike or Shahyar River along a previously unexplored route to the Kuchar oasis, where the ruins had lately been carefully explored by successive parties of Japanese, German, and Russian archæologists. So, after a hazardous desert march, he was glad to re-visit his old hunting-ground at Kara-dong. March and April were spent in examining the desert belt adjoining the oasis from Damoko to Khotan, and from a collection of unsavoury middens he recovered a great mass of documents, mainly Indian, Chinese, and Tibetan, none of which, apparently, is later than the eighth or ninth century A.D. At the beginning of May Dr. Stein reached Aksu, after suffering severely from heat and dust-storms. Here he arranged for the continuation of the survey of the outer Tien-shan range as far westward as the passes above Kashgar. After some further exploration the traveller was forced to return to Khotan, where, when this letter was dispatched, he was engaged in packing up his large collections, many of them consisting of fragile documents, which need much care, preparatory to sending them by the long and difficult route across the Himalaya to India.

WE have received a letter from Mr. C. V. Raman, of the Science Association Laboratory, Calcutta, directing attention to a method of illumination employed in microscopy by Mr. G. Dubern in 1888, and described in *Indian Engineering* for April of that year. Mr. Raman claims that the apparatus renders visible ultra-microscopic particles, and that Siedentopf's and Szigmondy's method was thus anticipated. The apparatus consisted of a polished glass plate, one end of which was cut off, forming an angle of 54° 35′ with the base; through this slant end a powerful beam of light was projected. We have examined the description of the apparatus in *Indian Engineering*, and consider that the method (not altogether novel even at that date) was one of dark-ground illumination, any form of which tends to render ultra-microscopic particles visible, but that it cannot be considered in any way as anticipating the modern ultra-microscopic apparatus.

IN addition to a memoir, with portrait, of Prof. W. Lilljeborg, the October number of *Naturen* contains an interesting account of the results of Mr. Luther Burbank's experiments in developing and hybridising various fruits, especially plums. Illustrations are given of the wild and cultivated forms of the French plum, of the "plumcot" (plum crossed with apricot), and of the hybrid blackberry and raspberry.

ACCORDING to *Museum News* for October, there has been installed in the Brooklyn Museum a case showing the home of the guacharo, or oil-bird, of Trinidad. The scene represents a cave tenanted by hundreds of these birds, with their nests, eggs, and young. The rainy season is the time of nesting, and the cave is consequently represented as dripping with water and the nests saturated. The cave is lighted by electricity, which can be switched on or off at pleasure. A group of five sea-lions forms another addition to the exhibited series. In the matter of realistic groups of this nature the Brooklyn and other American museums are leaving our own Natural History Museum far behind.

WE have to acknowledge the receipt of copies of articles 12–14 of the twenty-third volume of the Journal of the College of Science, Imperial University of Tokyo, the contents of all three of which are mainly of interest to specialists. Japanese sertularian zoophytes of the group Primnoidea form the subject of article 12, by Mr. K. Kinoshita, and are illustrated by several excellent plates in black and white. In No. 13 Mr. S. Tanaka treats of some rare Japanese fishes, with descriptions of one new genus, one subgenus, and six species, while in article 14 Prof. Einar Lönnberg, of Stockholm, contributes a list of the bird-fauna of the island of Saghalin, based on collections at Tokyo, in which three new subspecies are named. The new genus (Gymnosimenchelys) in Mr.

Tanaka's paper is represented by a small eel-shaped fish allied to Simenchelys, but scaleless.

IN view of the attention that is now being concentrated on the house-fly as a disseminator of disease, the appearance in the October issue of the *Quarterly Journal of Microscopical Science* of the second part of Mr. C. G. Hewitt's paper on the structure, development, and habits of the species is extremely opportune. In this portion the author deals with the breeding-habits and the anatomy and development of the grubs. After full reference to the work of previous naturalists, it is concluded that horse-manure is the favourite breeding-place, although decaying organic matter of almost any kind may form the *nidus* for the eggs. The rate of development depends entirely on temperature, and it is important to notice in this connection that the substance in which the eggs are laid is generally in a state of fermentation. The shortest time for development—from laying to the appearance of the perfect fly—is eight days, but the period may be extended over several weeks. There are three grub-stages. From June to October is the chief breeding-season, although under favourable conditions flies may be fertile all the year. The flies become sexually mature in from ten to fourteen days after their first appearance in the world, and they may begin to lay within a fortnight. Each fly may lay six batches of ova, each containing from 120 to 130 eggs. The "bionomics" of the species will be discussed in the third and final part of the paper.

THE spoliation of the Falls of Niagara, on account of the abstraction of the water for electrical and other works, forms the subject of an exceedingly interesting article in the October number of the *Popular Science Monthly*, by Dr. J. W. Spencer, who has devoted much attention to the study of rivers generally. After referring in more or less detail to the various power-stations connected with Niagara, the author notes the very great lowering of the water-level above the falls as the result of this tapping. As an example of the enormous amount of water taken by these works, it is stated that when in June last a single company temporarily stopped its take of 8000 cubic feet per second, the water in the basin rose no less than 6 inches, and at the edge of the American falls 1·2 inches. "The preservation of the falls," continues Dr. Spencer, "is now a question of inches. Under the conditions as set forth [*i.e.* as regards further tapping], the whole of the Horseshoe Falls will have shrunken from a crest-line of 2950 feet to 1600 feet, and their diameter will have been reduced from 1200 to 800 feet. They will then be entirely within Canadian territory, as the boundary line will become uncovered, leaving a narrow strip of rock between Goat Island and the great cataract. If the full franchise be used, the American Falls, which are 1000 feet across, will have their southern half drained, and will be further broken up into narrow sheets or strings of water." The preservation of the falls, it is added, now depends entirely upon the Governments of Washington and Ottawa; it is sincerely to be hoped that they will so regulate matters as to retain the world-renowned falls for all time. In a second article, by Mr. R. H. Arnot, the industries connected with the falls are described at length.

A THIRD part of the current botanical volume of the *Philippine Journal of Science* (July) contains a list of plants collected near Lake Lanao Mindaneo by Mrs. Clemens, and identified by Mr. Merrill; also a series of identifications of Philippine plants, in which Mr. R. A. Rolfe is associated with Mr. Merrill. A Ranunculus closely allied to the Australian *Ranunculus lappaceus*, the genera Hoppea and Hemiphragma furnishing an Indian element, and the genus Spiræopsis known only from the Celebes, are geographically interesting. Mr. F. W. Foxworthy records the identification of "lumbayao" timber as the product of *Tarrietia javanica*. The allied *Tarrietia sylvatica* furnishes the timber "duñgon," that is better known, but here reported inferior.

THE discovery in Siam of a new genus of the unique order Rafflesiaceæ is recorded by Dr. C. C. Hosseus in Engler's *Botanische Jahrbücher* (vol. xli., part ii.). The plants of this order are parasitic herbs, consisting of a vegetative structure reduced to a network of cellular threads ramifying in a host plant, and of flowers subtended by a few scale leaves. The new genus, Richthofenia, falls into the tribe Rafflesieæ, together with the genera Rafflesia, Sapria, and Brugmansia. It is similar to Rafflesia in the possession of a plurilocular ovary, but agrees with Sapria as regards its bilocular anthers. It thus forms a connecting link between the two genera. Its habitat, too, lies between the Malayan home of Rafflesia and the Himalayan locality of Sapria.

IT is fully recognised that considerable risks attach to the formation of pure forests owing to the liability of destruction by the rapid spread of insect or fungus pests. American investigators have provided another reason in favour of mixed plantations in so far as they attribute weight to soil deterioration by the excretion of toxic material from the roots. The editorial note in the *Indian Forester* (September) touches upon these points, and further arguments applying to conditions in India in favour of intermixing trees of less value are adduced by Mr. P. Lushington. Firstly, there is the fuel value to be considered, but, in addition, it is pleaded that "worthless" species provide cover for the ground, or may serve to draw up the high-class trees, or in the case of evergreens help materially to check forest fires.

THE Oxford list of British plants is one of three such publications recently issued, the other two being a list compiled by the botanical authorities at the Natural History Museum, South Kensington, and the tenth edition of the London catalogue. The South Kensington list is the most restricted, as the critical forms of Hieracium, Rubus, Euphrasia, and Salix are omitted, all varieties, also extinct and various introduced plants. A special feature is the reference to the original determination of each species. The Oxford list is, on the other hand, the most comprehensive, registering varieties and aliens of all kinds, or foreigners as some might be called. The London catalogue approximates to the Oxford list, differing chiefly in a greater discrimination of aliens. There is, however, one notable point of distinction in the latter, as Mr. Druce refuses to accept the list of special generic names passed by the Vienna Congress as worthy of retention. While respecting his opinion, it seems a mistake not to abide by the decision of the congress. To coordinate the species in the three publications may well be left to the ardent systematist. Doubtless all three will find supporters, besides being used for comparison. Certainly the Clarendon Press could have found no botanist better versed in the intricacies of the British flora than the author they have selected.

THE Journal of the Meteorological Society of Japan for July contains a discussion, by T. Ogawa, of the climate of Fusan (south-east of Corea) from observations since 1904. The seasonal means of air temperature are:—

spring, 53°·2; summer, 73°·0; autumn, 60°·8; winter, 38°·7. The extremes observed were 13°·5 and 92°·5; the periods of greatest cold and heat coincide approximately with our own. The annual rainfall is about $56\frac{3}{4}$ inches, the average number of rain-days being 109. There is a fairly large rainfall in every month from January to September, especially in July, but only a slight fall during the rest of the year. M. Ishida contributes an article on the causes of the very heavy winter rainfall in the western part of Honshu (facing the Sea of Japan). Abstracts of these articles are given in English.

THE programme of the Institute of Archæology and Anthropology in connection with the University of Liverpool is sufficiently ambitious; but with working members like Profs. Frazer, Newberry, and Myres it seems likely to achieve success. The Institute, so far as British archæology is concerned, proposes to conduct an archæological and historical survey of North Wales; and in the course of excavations here it is hoped to train a body of students who will be available for similar work abroad. Besides this, schemes are on hand for excavations in Egypt and British Honduras. As a record of its work, the Institute has commenced the publication of a series of "Annals of Archæology and Anthropology," under the editorship of Prof. Myres, of which the opening double number for September has lately appeared. It is chiefly devoted to Egyptian and Hittite archæology. In the latter field the most interesting contribution is the account by Prof. Garstang of Dr. Winckler's excavations at Boghazkeui, in Cappadocia, where the discovery of a copy of the treaty between the Hittite monarch and Rameses the Great fixes for the first time a definite date on which the chronology of the Hittite empire can be safely based.

DR. G. A. AUDEN, medical superintendent under the Educational Committee of Birmingham, has, with the assistance of Miss Byron, done a useful service to archæology by issuing, side by side with the Danish and German editions, an English version of the new guide to the prehistoric collections in the Danish National Museum at Copenhagen, which has been compiled by Dr. Sophus Müller. This is more than a catalogue of the important series of specimens discovered in Danish soil, because it will serve as a useful introduction to the study of a branch of archæology which has hitherto received too little attention in this country. The manual is divided into periods: the earlier and later Stone and Bronze ages; the pre-Roman and Roman Iron ages; the post-Roman Iron age; and, finally, the Viking period. It is illustrated throughout with excellent engravings. As a concise account of north European prehistoric antiquities it may be usefully consulted side by side with the admirable guides to the collections in the British Museum for which we are indebted to Mr. C. H. Read.

THE bright lines or streaks seen when moonlight is reflected from water that is covered with regular ripples, or the light of a lamp is reflected from a corrugated or regularly polished surface, have often formed subjects for questions in the few examinations in which geometrical optics figures in this country. In a paper in the Transactions of the American Mathematical Society, ix., 3, Prof. W. H. Roever discusses the general mathematical theory of "brilliant points" on curves and surfaces, and his paper is illustrated by photographs of the brilliant lines on the surface of a circular saw which had been polished in rotation.

THE *Physical Review* for September contains an article on the diffusion of salts in aqueous solutions, by Mr. R. Haskell, of the Massachusetts Institute of Technology, in which the theory of diffusion is brought into line with the dissociation theory of solutions. The dissolved salt is taken as partially dissociated, and the theory is worked out on the supposition that the diffusion of each molecule is proportional to the rate of change per cm. of the concentration of that molecule, whether dissociated or not, multiplied by a constant called the diffusion constant, which may have different values for a dissociated and for a non-dissociated molecule. The measurements were made by determining the electrical resistance between pairs of platinum electrodes placed at different heights in a vertical cylinder filled initially with pure water, with a layer of concentrated solution at the bottom the strength of which was maintained from an external reservoir. The author finds the theory confirmed by his observations on thallium sulphate and barium nitrate, and in both these cases the diffusion constant for dissociated is double that for non-dissociated molecules.

WE have received from *Knowledge* a specimen of the *Knowledge* calculator, which has been designed by Major B. Baden-Powell, and is put on the market at the low price of 3*s*. 6*d*., or 3*s*. 8*d*. by post from the *Knowledge* Office, 27 Chancery Lane. The calculator is in reality a circular slide-rule made in card. As the diameter of the circle is almost exactly 6·5 inches, it is equivalent in openness of scale to a straight rule, divided from 1 to 10 only, $20\frac{1}{4}$ inches long, or to a straight rule divided from 1 to 100 of twice that length. A considerable number of gauge points or conversion factors are marked round on the inner card, and directions are given at the back for using the instrument. The advantage of openness of scale of the circular form has to be set against certain other advantages of rules of the Gravet type which, in the writer's opinion, are the more valuable; still, whether one or other form is to be preferred must, of course, be determined by each user for himself. It does not seem probable that any other form of circular rule made of card could be designed so as to be more effective and inexpensive than this.

THE existence of a perchromic acid has been known for the last sixty years, and the blue coloration resulting from the action of sulphuric acid and hydrogen peroxide upon chromates has taken its place as a useful test for chromates. In spite of many researches, however, the exact constitution of these perchromates has remained doubtful. In the August number of the *Berichte der naturforschenden Gesellschaft zu Freiburg i. Br.* there is a paper by E. H. Riesenfield in which the whole of the work on this subject is reviewed, and further experiments described settling the composition of these compounds. Four definite series of perchromates are described:— H_3CrO_8, giving red salts with sodium, potassium, and ammonium; H_3CrO_7, giving blue perchromates; KH_2CrO_7 and $(NH_4)H_2CrO_7$; the pyridine salt of the perchromic acid, $HCrO_5$; and the ammonia addition product of perchromic anhydride, CrO_4. All these compounds are analogous, and are convertible the one into the other under suitable conditions.

MESSRS. WILLIAMS AND NORGATE has published vol. viii. of the new series of the Proceedings of the Aristotelian Society. The volume contains Mr. Haldane's presidential address on the methods of modern logic and the conception of infinity, the papers read before the society during the session 1907–8, an abstract of the minutes of the proceedings of the society for the session, the rules, and a list of officers and members of the society. The price of the volume is 10*s*. 6*d*. net.

We have received from the Pulsometer Engineering Co., Ltd., a copy of their latest catalogue of "Geryk" air-pumps. The list also contains a full description of the Fleuss patent pump for desiccating or for steam condensers, which has been awarded a diploma for a gold medal in connection with the Franco-British Exhibition. These pumps are specially designed for desiccating, chemical work, distillation, and so on, their special feature being that they will pump condensable vapours of alcohol, ether, &c., to a high vacuum as readily as ordinary dry air.

Dr. Robert A. Lyster's "School Hygiene," published by Mr. W. B. Clive, has reached a second edition. A chapter dealing with the organisation of medical inspection in schools has been added to the new edition.

Messrs. George Bell and Sons have published an eighth edition of Dr. Percy Groom's "Elementary Botany." Two new chapters have been added, dealing respectively with "Form and Function" and "Soil and Distribution of British Plants," and some additional notes have been interspersed in the text.

A fourth edition of Mr. J. M. Lowson's "Text-book of Botany" has been published by Mr. W. B. Clive. The book has been enlarged by the addition of new matter, and several changes have been made. The sections dealing with the stelar theory have been re-written, and the life-history of Hæmatococcus, and a chapter on ecology and plant distribution, have been introduced.

The first part of a work on the "Geologie der Steinkohlenlager," by Dr. Dannenberg, has been published by the firm of Gebrüder Borntrager, Berlin. The second volume will probably appear at the end of next year, and we propose to defer our notice of the work until that part reaches us.

OUR ASTRONOMICAL COLUMN.

The Spectrum of Comet Morehouse, 1908*c*.—In a communication to the *Comptes rendus* (No. 16, October 19, p. 666) MM. A. de la Baume Pluvinel and F. Baldet give an account of the spectrum of comet 1908*c* as photographed by them at the Juvisy Observatory on October 4, 5, and 7.

The instrument used was that previously employed for the photographing of the spectra of comets 1902*b* and 1907*d*, an objective-prism camera of 0·08 m. aperture and 0·30 m. focal length, the angle of the prism being 20° 18′; the results are, therefore, comparable. Wratten's "pinacyanol" plates were used.

On each plate there appear seven monochromatic images of the comet, of which the approximate wave-lengths are 465–458, 448, 421, 397, 388–385, 376, and 367. Of these, the first image was faint and without a tail, the second more intense, with tail, the third the most intense of all, with a very extensive tail, and the fourth was but a little less intense than the third. The image at λ 388–385 was of an extended nebulous character degrading towards the violet, the tail being confused. Evidence of change appears at λ 376, for whilst a tail accompanies the feeble image obtained on October 5, there is none accompanying the more intense image of October 7; the image at λ 367 is extremely faint.

The spectrum displays the absence of the hydrocarbons, which were a feature of that of Daniel's comet, whilst the complete system of the cyanogen spectrum—so far as possible under the observing conditions—is represented; usually the band at λ 388 only is represented in cometary spectra. The origin of the radiation at λ 397 is unknown. The monochromatic images of the tail extend to some 34′ from the nucleus, thus being relatively long as compared with those of Daniel's comet, despite the fact that the nucleus of the latter was more intense.

Solar Vortices and their Magnetic Effects.—An account of an interesting research by Prof. Hale on solar vortices and their magnetic effects appeared recently in this Journal (August 20, pp. 368, 369). Prof. Zeeman also contributed an account expressing his opinion as to the interpretation of the results obtained. Prof. Zeeman has now sent us an advance proof of a communication he made to the meeting of the physical section of the eightieth gathering of the Deutscher Naturforscher und Ärzte at Cologne on September 23, which contains further important results communicated by Prof. Hale.

It will be remembered that Hale examined the spectrum of a sun-spot situated near the middle of the solar disc, using a Fresnel rhomb and Nicol prism mounted in front of the slit of the spectroscope, and obtained results which indicated the Zeeman effect. When a sun-spot is near the middle of the solar disc, the direction of the light from the spot is along lines of force which are at right angles to the plane of the vortices in which the electric currents are encircling. The changes in the lines in the spectrum of the spot are due, therefore, to the "longitudinal effect," as termed by Voigt, and this is what Prof. Hale observed.

If now the sun-spot be on the limb of the sun, the light from the spot will be observed in a direction at right angles to the lines of force, or in the plane of the circulating electric currents. The lines in the spectrum should then be plane polarised, and show the "transversal effect." The important new fact which Prof. Zeeman gives in his paper is that this observation has now been made by Prof. Hale, who has reported as follows:—"Vortices rotating opposite directions show opposite polarities; spot lines near limb plane polarised."

The observations of both these longitudinal and transversal effects indicate very conclusively that sun-spots are very intense magnetic fields, and this important discovery will certainly stimulate work on many allied investigations.

The Wave-length of the Hδ Line.—In No. 2, vol. xxviii., of the *Astrophysical Journal* (p. 162, September), Mr. Evershed gives the results he has obtained from measurements of the wave-length of the Hδ and Hε lines in the solar spectrum.

Previous observers have called in question Rowland's value (4102·00) for the Hδ line, but, according to Jewell, the position given in the "Preliminary Table of Wave-lengths" is most probably correct.

On photographs taken with a specially designed grating spectrograph, during 1907, Mr. Evershed measured the fine absorption line superposed on the bright emission line of the chromosphere, a spectrum suitable for this purpose being obtained by placing the slit of the spectrograph slightly within the limb of the sun's image. The results obtained were not numerous or accordant enough to give a definitive value for Hδ, but they do show conclusively, in Mr. Evershed's opinion, that the line does not differ appreciably from its theoretical position derived from Balmer's formula for the series. The recently determined mean value is 4101·900, the theoretical value being 4101·893. From measurements of the bright Hε line, Mr. Evershed obtains the mean value λ 3970·212, whilst the theoretical value is 3970·225.

Meteoric Iron and Artificial Steel.—From the council of the Iron and Steel Institute we have received a reprint (No. 3, 1907) from the Journal which contains a paper by Prof. Fredk. Berwerth, of Vienna, in which the author shows that there is a close connection between meteoric iron and steelworks' steel. Many of the characteristics of meteoric irons can be reproduced artificially, and Profs. Arnold and McWilliam have even been able to produce a steel, with 0·39 per cent. of carbon, on which the Widmannstätten figures can be formed.

Proceeding, Prof. Berwerth gives a list of fifteen constituents of meteoric irons and their compositions, and also directs attention to the comprehensive character of the collection of meteorites to be found in the Imperial Natural History Museum at Vienna. This collection includes falls from 615 different localities, weighing altogether nearly 3½ tons. Of these, 232 are iron, 28 iron or stone, and 355 stones without iron.

THE SCIENCE FACULTY OF THE UNIVERSITY OF LONDON.

AT the meeting of the faculty of science on October 30, which was held in the lecture-room of the physiological laboratory of the London University, Prof. J. Millar Thomson, F.R.S., was unanimously elected dean of the faculty in succession to Dr. Augustus D. Waller, F.R.S., who gave the following address in vacating this office. Dr. Waller said:—

"In vacating the chair that I have had the honour to hold during the last four years as dean of the faculty of science, it may be expected of me that I should review the work of the faculty during that period.

"I shall not, however, attempt to draw up any elaborate digest of the proceedings recorded in our minutes. I shall limit myself to directing your particular attention to two subjects that in my opinion are calculated to be of cardinal importance in the future development of the faculty, and that have been prominent before my mind during my term of office.

"The first of these two subjects relates to the faculty board, composed of the representatives of its several boards of studies. In the constitution of the University, as reformed ten years ago, the official organs of intermediation between the teachers and the Senate are the boards of studies, and the several faculties in relation to those boards on the one hand, and to the Senate and academic council on the other, have been purely consultative, occasional, and of little significance. The official and regular function of the faculties is little more than electoral; every four years it elects two representatives on the Senate.

"It is recognised by those responsible for the development of the University that each faculty is properly the place of convergence at which the particular interests and requirements of its boards of studies should be united, coordinated, and promoted. Under the present constitution the official utterances of individual boards are liable not to produce their due effect in the councils of the University. The faculty itself is too large and in other ways unsuitable for the adequate discussion of practical details. Yet if the influence of its boards of studies is not to be frittered away piecemeal, it must be united and unified by means of the faculty. It is this unification of educational interests that will be the principal function of the faculty board, composed as it is of representatives of all the boards of studies concerned.

"The full remedy of subdivision of influence is not possible under the present statutes of the University, but a very considerable step in the right direction can be taken if full use is made of the faculty board, at which the opinion of each particular board of studies can be considered and modified if need be, and reinforced by the opinion of related boards. Full expert discussion of educational requirements at the faculty board, and, if need be, at the faculty itself, would promote the interests common to all studies far more effectually than is the case at present.

"The second subject to which I wish to invite the attention of the faculty relates to the organisation of means for the advancement of science and learning. We know this University as an organ of examination. We are assisting at the consolidation and development of its teaching side at its colleges and schools and at the University itself.

"The highest function of education is the fostering of initiative, in which the acquisition of further knowledge by the teachers of already acquired knowledge is the principal factor.

"The University can fulfil its statutory duty to 'promote research and the advancement of science and learning,' not only by its fostering care of its colleges and schools, but by itself acting as a focus of light and leading, served by the collective efforts of all its college teachers, serving thereby the collective interests of all its colleges.

"The room in which we are now met represents an outcome of that tendency. We are attempting to accomplish in physiology a typical concentration of its best elements such as we believe to be desirable in the case of all the principal subjects, belonging to letters as well as to science.

"During the past six years all the teachers of physiology in London, as well as several teachers of physiology belonging to the great provincial and colonial schools, have contributed of their best knowledge in this lecture-room. I do not propose to weary you by proclaiming to the faculty the special requirements or the special merits of any one branch of science. All that I feel justified in doing is to indicate to the faculty of science a concerted effort within the domain of that subject that I believe to be worthy of consideration in other provinces of science and learning.

"I shall, however, lay stress in conclusion upon what I conceive to be the most special and most hopeful sign of merit in this six-year-old object-lesson in the organisation of learning. The principal concern of this lecture-room consists in knowledge at first-hand, knowledge in the nascent state and in the making. The best teachers and many of the best students of practically all the colleges and schools of the University have assisted in its work. The colleges have given of their best, knowledge at first-hand communicated by the men who have gathered it. And the gift has augmented the wealth of the givers.

"I shall be confirmed by every physiologist when I state that during the last few years physiological education has been promoted by the special courses of advanced lectures in physiology, that have become established in the colleges as well as at the University itself.

"The gift of the colleges to the University has been to the gain of the University and to the gain of the colleges.

"Shall I be held as too sanguine if, in conclusion, I venture to hope that in the great efforts required of the University to fulfil its function as a seat of learning the feeble effort made during the last six years in a limited province within the faculty of science may not prove to have been quite fruitless?"

ENTERIC FEVER IN INDIA.

THE subject of enteric or typhoid fever is of considerable importance in India, particularly to the British troops stationed there, and the Indian Government has therefore been well advised to institute an inquiry into the factors influencing the occurrence of the disease.[1] The work has been carried out under the direction of Lieut.-Colonel Semple, I.M.S., and Captain Grieg, I.M.S., at the Central Research Institute, Kasauli. The problems to be solved were:—(1) What is the nature and duration of the saprophytic life of the *Bacillus typhosus*? (2) What is the duration of the life of the *Bacillus typhosus* within the human host? (3) How are epidemics produced? As a result of a large series of experiments and observations, evidence is brought forward to show that (1) the *Bacillus typhosus* continues to be excreted for long periods in the urine and fæces of a certain percentage of patients convalescent from enteric fever, the number in the urine being very large, and the excretion being markedly intermittent; (2) the "chronic bacilli carrier" exists in different units in India, and can cause epidemics and cases of enteric fever; (3) enteric fever orderlies may become "chronic bacilli carriers"; (4) in India the saprophytic existence of the *Bacillus typhosus* outside the human host is short. Thus in fæces and in urine kept at 80° F. in the dark, the typhoid bacillus had died out in ninety-six hours and seventy-two hours respectively, and an exposure to the sun of thin cotton and of blanket soaked with urine containing typhoid bacilli for two hours and six hours respectively proved fatal to the organism.

The general conclusion arrived at is that the problem of the prevention of enteric fever among the British troops in India is the detection and isolation of the individual harbouring the *Bacillus typhosus*. We should have expected, however, some reference to anti-typhoid vaccination in this connection.

The report is a very valuable one, and contains the details of the experiments performed and tabular statements of the cases investigated.

[1] Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India. No. 32. (Calcutta, 1908.)

THE LIME TREE AND ITS PRODUCTS.[1]

ONE of the most promising of the newer industries of the West Indies is the cultivation of limes. Lime products, at the present time, form the principal exports from the island of Dominica, and are second only to cotton in the island of Montserrat. Large tracts of land have recently been taken up in British Guiana for the cultivation of lime trees, and progress is being made at St. Lucia, Carriacou, and elsewhere.

Lime fruits in a fresh condition are now largely exported from Dominica to New York, London, and Manchester. They can be used for every purpose to which the lemon is put, and are considered more economical. Raw lime-juice is exported for making cordials, and the concentrated juice forms one of the principal sources of commercial citric acid. The essential oil, both hand-pressed and distilled, is of value in perfumery.

The tree appears to be confined to tropical and subtropical zones, and has not nearly so extensive a range of growth as the orange or lemon. In these circumstances the West Indian Department of Agriculture is well advised to issue clear and popular instructions for planting and cultivating the tree, and for dealing with the various products. The Department has, indeed, gone further, and has distributed many thousands of lime plants; in consequence, the value of the exports last year from Dominica was more than 77,000*l*. Of the two varieties, the ordinary spiny and the spineless, the juice from the latter appears to be the purer and richer in acid.

"The A.B.C. of Lime Cultivation" is drawn up by Mr. Joseph Jones, curator of the Botanic Station at Dominica, and Mr. J. C. Macintyre, a large grower. It gives a concise but eminently readable account of the crop, and merits more than a local circulation.

Dr. Watts deals in the West Indian Bulletin with the question of citric acid. It appears that manufacturing chemists prefer buying calcium citrate rather than the concentrated lime-juice, and Dr. Watts describes methods of preparing the salt. Chalk is added in proper quantity to the juice, and the precipitated citric acid is allowed to settle, is then washed with hot water and dried. At present drying constitutes a great difficulty; the experiments show that a centrifugal machine works well, but the best type still remains to be determined, and many other details of the manufacture have also to be worked out.

The whole industry appears to be a very promising addition to the resources of the West Indies, and the Department of Agriculture is to be congratulated on the vigorous action it is taking.

[1] "The A.B.C of Lime Cultivation" (Imperial Dept of Agriculture for the West Indies, 1908.)
Bulletin of the Department of Agriculture, Jamaica, 1908. Vol. vi. Parts ii. and iii.
West Indian Bulletin. Vol viii., pp. 167–172.

MATHEMATICS AND PHYSICS AT THE BRITISH ASSOCIATION.

THE president of Section A (Mathematical and Physical Science) delivered his address on Thursday, September 3. This address has already appeared in full in NATURE of September 3 (p. 425). It was followed by an important discussion on the isothermal layer of the atmosphere. Of this, also, a detailed account has already been given in NATURE (October 1, p. 550).

Prof. W. F. Barrett (who was one of the vice-presidents of the section) concluded the morning's proceedings with an account of an ingenious combined optometer and entoptiscope. On meeting again after lunch various reports of committees were taken. The committee on improving the construction of practical standards for electrical measurements directed special attention to the conclusion of the electrical measurements of certain of the fundamental units which have been in progress for some time at the National Physical Laboratory. The E.M.F. of the Weston cadmium cell as set up in the laboratory is given as $1{\cdot}0183_0$ at 17° C. Six forms of silver voltameter give (with proper precautions) the value 1·11827 milligrams for the silver deposited by 1 ampere per second. There are two important appendices to the report:—(1) on the secular changes of the standards of resistance at the National Physical Laboratory, by F. E. Smith; and (2) specifications for the practical realisation of the definitions of the international ohm and international ampere, and instructions for the preparation of the Weston cadmium cell. The other reports read were those rendered by the committees on kites, geodetic arc in South Africa, meteorological observations on Ben Nevis, and magnetic observations at Falmouth Observatory.

The large number of papers down for reading in this section made necessary a separation on three of the days into three departments, which sat concurrently. This trifurcation began on Friday, September 4. The mathematical department began with the reading of the report of the committee on the further tabulation of Bessel functions. Dr. T. W. Nicholson then communicated some formulæ useful for the computation of Bessel functions when the order and the argument are both large. Dr. E. W. Hobson followed with a paper on Sir W. Hamilton's fluctuating functions. In this paper Dr. Hobson reviewed and criticised Hamilton's work, and he specially directed attention to the extraordinarily sure instinct with which Hamilton anticipated many of the results of the modern theory of the definite integral, and steered clear of the many pitfalls which surround this particular subject, in spite of the imperfect and often erroneous ideas on this matter which were current at the time among mathematicians. Prof. Lamb, in the discussion which followed, referred to this point, and remarked that the inaccuracy of the methods of the older analysts was often more apparent than real, because they took for granted much of which they were aware, but which it is now the fashion to write down explicitly.

Dr. S. H. Burbury then read a paper on the law of equipartition of energy, in which he showed that this law was really independent of the Boltzmann-Maxwell assumption that the variables were uncorrelated. Prof. J. C. Fields gave an account of a new proof of a theorem recently discovered by himself, to which he has given the name of the complementary theorem. The full statement of the theorem, which deals with properties of algebraic functions of a complex variable, is somewhat long, but the theorem is of a most general character, and includes a large number of important results previously known. Mr. Robert Russell explained a new method of introducing the elliptic functions. Denoting the expression

$$a_0x^4+4a_1x^3+6a_2x^2+4a_3x+a_4$$

by $f(x)$, and by δ one root of $f(x)=0$, he considered the functions

$$u=\int_\delta^x \frac{dx}{\sqrt{f(x)}} \quad v=\int_\delta^y \frac{dy}{\sqrt{f(y)}}$$

He then showed by simple reasoning that the expression

$$\frac{x-y}{(x-\delta)(y-\delta)}$$

was invariant for transformations of the type

$$x=(l\xi+m)/(l'\xi+m')$$

and thence that a function ϕ existed such that

$$\frac{x-y}{(x-\delta)(y-\delta)}=\phi\frac{(u-v)\,\phi\,(u+v)}{[\phi(u)]^2[\phi(v)]^2}$$

This function ϕ, then, turns out to be no other than the ordinary σ-function, which, in this method, is therefore fundamental.

Mr. Russell also gave a new proof of Legendre's identity

$$EK'+E'K-KK'=\frac{\pi}{2}$$

Commenting upon the paper, the chairman (Prof. A. E. H. Love) mentioned that he had recently devised a physical proof of Legendre's identity by considering the magnetic potential of a circular current.

The proceedings of the general physics department began with a paper from Sir W. Ramsay with the title "Do the Radio-active Gases (Emanations) belong to the Argon Series?" The experimental part consisted in the examination of the residues of the fractionation of 120 tons of liquid air with the object of discovering new elements. The final residue of 0·3 c.c. had a spectrum differing in no respect from xenon, and it is concluded that if there is a heavier constituent in air than xenon its amount does not exceed 1/25 billionth of the whole. A consideration of the periodic table reveals gaps at 178, 216, and 260, and it is rendered probable that they are respectively unstable emanations, viz. those of thorium, radium, and actinium. Discussing this paper, Prof. Rutherford outlined his well-known argument from the mode of disintegration of uranium and its successors that radium emanation has an atomic weight of 222, but did not attribute importance to the difference between this and 216. It is not possible to apply the same argument to the other radio-active elements, because more than one alpha particle may be thrown off at a time. Actinium, he thought, might belong to a side branch. It seemed improbable that there should be an emanation higher than uranium, and therefore he discountenanced the view that the value 260 belonged to actinium emanation. Mr. S. Russ observed that he recently made a direct comparison between the coefficients of diffusion of the emanations from thorium and actinium, with the result that the molecular weight of that of actinium is *less* than that of thorium. Sir W. Ramsay, in replying, urged that Prof. Rutherford had left out of account the production of neon, which must be explained by the occurrence of a group of alpha particles. Prof. Rutherford rejoined that he was not convinced of the production of neon in radio-active changes.

Mr. W. Makower followed with a paper on the number and absorption of the β particles emitted by radium. The law of absorption by glass found for the β rays from radium B and C is the same as that for aluminium found by H. W. Schmidt, the radiation being measured in both cases by the ionisation produced by the rays after traversing different thicknesses of glass. It was found to be the same when measured by the *charge* received by an insulated brass cylinder (which surrounded the glass tube containing the emanation), different thicknesses of glass being interposed. It is concluded that when rays pass through matter the absorption is not due to scattering, but to an actual stoppage of the particles. The number of β particles emitted per second by the radium C in equilibrium with 1 gram of radium is found experimentally to be $4{\cdot}9\times10^{10}$. Prof. Rutherford explained that the value he expected from theoretical considerations for the number from both B and C was $6{\cdot}8\times10^{10}$ instead of $9{\cdot}8\times10^{10}$ as deduced from Mr. Makower's experiments. To remove the discrepancy we might assume not merely one α for one β particle. Prof. McClelland welcomed the view that scattering is not an important factor, though his recent experiments show that some scattering is present, together with a *sending out* of secondary particles. Prof. J. J. Thomson had not the slightest doubt, from his own experiments, that there is a large amount of scattering, and that absorption is due to this divergence. The ultimate fate of a particle may be that it sticks in, but it is repeatedly deflected first. Prof. H. A. Wilson expressed an interest in the subject, partly on account of its bearing upon his suggestion of the *smallness* of the α particle. Sir O. Lodge tried to reconcile the opposing statements by asking whether it is not necessary to distinguish between absorption by conductors (as in Prof. J. J. Thomson's experiments) and by non-conductors (as in Mr. Makower's).

An account was next given by Sir J. Dewar of his recent work on the rate of production of helium from radium (*v.* Proc. Roy. Soc., A, vol. lxxxi., No. 547, p. 280). After extreme precautions, the rate of production is found to be about 0·37 cubic mm. per gram per day, a number which is of the same order of magnitude as Rutherford's theory requires. Turning to the question of the helium in the atmosphere, he considered that two or three million years would be required to produce it from rocks. Prof. R. J. Strutt remarked that 100 billion tons of rock would be required if the supply of helium were kept up in this way. Probably the supply is supplemented by a store in the interior of the earth. A difficulty in making a trustworthy estimate of geological time arises from the fact that helium escapes. Sir O. Lodge pointed out that the rock required would only occupy 20 kilometres cube—a very moderate amount.

In the department of cosmical physics, Prof. J. Milne, in introducing the report on seismological investigations, remarked on the necessity for accurate time signals in seismological work and the difficulty of arranging terms with the Post Office for the transmission of such signals to the central observatory at Shide. After a short explanation of the instrumental records obtained and a statement of the shocks noted in 1907, he proceeded to point out that earthquakes travelled more freely towards the west, or against the motion of the earth, than towards the east, while very few earthquakes travelled across the equator. A very important section of this year's report is a catalogue of nearly 900 earthquakes recorded in China between 1800 B.C. and 1834 A.D.

The remaining papers were astronomical in character. Sir Robert Ball described a generalised instrument presenting the features common to the altazimuth, meridian circle, prime vertical instrument, equatorial, and almucantar, and a single set of equations represented the coordinates of the star relatively to three rectangular axes which could be defined in the generalised instrument.

Sir Howard Grubb described a new form of divided object-glass telescope in which the two half object-glasses are reversed and placed back to back; this arrangement permits the use of the necessary diaphragms, and a circular wedge is conveniently employed over one half for producing a relative shift of the rays through the two halves. Sir Howard Grubb also read a paper on the reflecting telescope and its suitability for physical research—an historical account of the subject. In the discussion Prof. H. H. Turner emphasised the importance of Common's work in connection with the reflecting telescope, and Sir D. Gill advocated the use of the Cassegrain form modified by Hale. Father Cortie described a reflector he had used at Stonyhurst for solar work, and mentioned the advantage of speculum metal over silvered glass for violet and ultra-violet light.

Sir Howard Grubb gave a description of the new spectroheliograph for the Madrid Observatory, which, instead of sliding in a straight line as usual, describes the arc of a circle of which the object-glass for focussing the sun's image is the centre.

A paper was next read by Prof. H. H. Turner on the relation between intensity of light, time of exposure, and photographic action. Representing these by the letters I, t, and E respectively, a new law, $E=It^{0{\cdot}8}$, is given as closely representing the facts concerning stellar photographic effect instead of the law $E=It$. This means that with an increase of exposure equivalent on the old scale to five magnitudes only four were obtained. Sir W. Abney stated that since the sensitiveness of a plate is different for different wave-lengths, the full equation must contain a term involving λ. Mr. R. T. A. Innes suggested the possibility of an influence arising from the diameter of the stellar image. Sir D. Gill felt that the law should be accepted with reservation, since different observers obtained different results, but Prof. Turner, in replying, contended that all observers got the same results if they only knew it.

Prof. F. W. Dyson contributed a paper on the systematic motion of the stars, which gives the results obtained so far from an unfinished investigation. It appears that the stars of large proper motion ($>20''$ per century) have apparent drifts to two points in the sky, but a difficulty is presented in the explanation of this as due to two streams. Mr. A. S. Eddington thought that the inequality in the numbers of stars in the two streams could be explained by the omission of stars of small proper motion, but admitted that his own results might ultimately require modification.

The proceedings on Monday, September 7, began in general session with a discussion on the theory of wave motion. This was opened by Prof. Horace Lamb, who explained that his object was to establish a better understanding between students of mechanics and meteor-

ologists and other men of science who were confronted by phenomena in which the characteristics of wave motion appeared prominent. First there were the large-scale oscillations of the atmosphere, shown in the oscillation of barometric pressure. These waves were not mainly gravitational. The principal periods of their free oscillation are 22, 16, . . hours. If we take into account the rotation of the earth, the character of the oscillation and the periods are modified. Laplace's theory of the tides, which has been very much improved by Hough, applies to an ocean covering the globe, and the only difficulty that arises when we wish to apply this to the atmosphere comes from differences of temperature. If we neglect these differences and apply Hough's theory to the atmosphere, the second type of oscillation has a period of about twelve hours. If we examine the facts as recorded by the barometer, we find the well-known diurnal oscillation irregular in amplitude and phase, and depending in a marked way on the height above sea-level, and, secondly, the semi-diurnal oscillation, extremely regular in amplitude for places in the same latitude and in phase for places in the same longitude.

The first thing that suggests itself is that this is a tide caused by the sun's attraction; but the corresponding lunar tide ought to be more marked, whereas, actually, the lunar tide is almost absent. Moreover, the phase is wrong in sign, and it is too big. Lord Kelvin was the first to suggest that the semi-diurnal tide was a temperature effect. The daily variation of temperature is not harmonic, and when it is analysed there is a definite component with a half-day period. The objection to attributing the semi-diurnal pressure variation to this is that the latter is extremely regular, while the temperature variation changes considerably with the locality. Margules has shown that on a rotating earth the period of free oscillation of the atmosphere lies very near to twelve hours, and consequently a forced oscillation of this period would be magnified.

Passing on to local oscillations, Prof. Lamb said these were probably mainly gravitational. The atmosphere might be treated as an incompressible fluid because of the relatively large value of the velocity of sound.

If we have two fluids of densities ρ and ρ', with a horizontal surface of separation, the velocity of waves at this surface is $\sqrt{\frac{g\lambda}{2\pi}\frac{\rho-\rho'}{\rho+\rho'}}$. Waves of this type occurring in the atmosphere would not appreciably affect the barometer at a place some distance below the surface of separation owing to the fact that the intensity of the disturbance diminishes exponentially. Only in the case of very long waves should we expect the oscillation to be shown on the barometric curve.

If the upper fluid is the denser, the amplitude of the disturbance increases rapidly, and we may get a series of filaments as the result of disturbance. So long ago as 1857 Stanley Jevons conceived the possibility of cirrus clouds arising in this way, and made experiments with liquids in verification.

If the change of density is not abrupt, but takes place across a transition layer, the character of the motion may change. It is probable that the structure of the disturbance will be larger. If we have difference of velocity as well as of density, the wave-velocity at the surface of separation is given by

$$V=\frac{\rho v+\rho' v'}{\rho+\rho'}\pm\sqrt{\frac{g\lambda}{2\pi}\frac{\rho-\rho'}{\rho+\rho'}-\frac{\rho\rho'}{(\rho+\rho')^2}(v-v')^2}.$$

If λ is small, the expression under the root becomes negative, indicating that the condition of affairs is unstable. This instability is more effective than viscosity in reducing an abrupt change of velocity to a gradual change taking place across a transition layer. The question then arises as to whether we get rid of the instability when the change becomes a gradual one. Helmholtz investigated the problem of waves at a surface of separation in the atmosphere. He concluded that, instead of instability, we might have waves of permanent type of finite amplitude. The question of the stability of these waves is still an open one.

In the application to the atmosphere it is deduced that at the crests of the waves there may be sufficient condensation through the expansion and cooling of the air to make the crests visible. Before this can be settled we need a picture of what really does happen when we cross a layer where these wave-like clouds are formed. Mathematicians have gone nearly as far as they are able without precise information on such points.

Dr. Shaw then showed some lantern-slides illustrating wave motion in the atmosphere recorded by the micro-barograph. In some cases a large sudden increase or decrease in the pressure was followed by a series of waves falling off rapidly in intensity. In other cases similar sudden changes were unaccompanied by waves, while in others still waves were formed without any sudden change occurring. He suggested the possibility of a current of air in rapid motion acquiring a dynamical stability as the result of the motion in such a way that a disturbance of the current might produce an oscillation of the current as a whole in a horizontal direction.

Mr. Wedderburn gave the results of observations of temperature in Loch Ness, showing how temperature oscillations arose from the circulation of the water. He showed the results of experiments on the circulation of water in a vessel of parabolic cross-section over which a strong current of air was passing. The liquid circulated in two distinct systems with a definite surface of separation.

Sir William White spoke on ocean waves and on the importance of the new experimental tank to be set up at the National Physical Laboratory.

Prof. Lamb's paper has been ordered to be printed in full in the report.

At the conclusion of this discussion the section again trifurcated.

In the department of mathematics, Sir Robert Ball opened the meeting with an account of the physical applications of the theory of screws, and referred specially to the excellent work done by the late Prof. C. J. Joly on quaternions, in which the present paper had its origin. Sir Robert showed that the theory of linear vector functions was really identical with that of the composition of screws, and that the whole subject became thereby much simplified, and the formulæ far more concisely expressed.

Dr. T. W. Nicholson read a paper on the inductance of two parallel wires. The author stated that the ordinary formula is inaccurate when the currents are of high frequency; in the present paper new formulæ are given which give a correct result for frequencies as high as 10^8.

Prof. F. Purser contributed a paper on the æther stress of gravitation. Maxwell had selected as a particular solution of the fundamental equations a pressure $R^2/8\pi$ along the lines of gravitating force, and an equal tension perpendicular to these lines, R being the resultant force of gravitation on unit mass, but there are difficulties in accounting for these by corresponding strains. Prof. Purser shows that the difficulties are removed if we consider that we are not bound to Maxwell's special solution, but may take such a solution as may be deduced from a state of strain according to the laws for (say) a homogeneous isotropic æther.

Several papers were taken as read in the absence of the authors.

The proceedings in the department of general physics commenced with a paper by Sir W. de W. Abney, K.C.B., on a new three-colour camera, in which the stereoscopic effect arising when three images are taken simultaneously by three lenses lying side by side is reduced to a minimum. Incidentally, it was pointed out that in this camera the mirrors are made of steel varnished with celluloid dissolved in acetone. Dr. Harker directed attention to Cowper-Coles's use of metallic cobalt, and Prof. W. F. Barrett, who was in the chair, strongly recommended galena for the purpose.

Sir Oliver Lodge described a new method for measuring large inductances containing iron which has been devised by him in collaboration with Mr. Benjamin Davies. A special galvanometer, consisting of a well-damped coil moving *dead beat* in a strong magnetic field, is connected in series with the inductance and a specially designed alternator giving a simple harmonic current. A switch enables the inductance to be suddenly replaced by a non-

inductive resistance R′, which is adjusted until the amplitude of oscillation is the same in both cases. Then the self-inductance is R′ divided by the frequency-constant of the alternator. The strength of the current involved in this measurement is known by imitating the deflection with a known steady current.

Prof. A. M. Worthington then showed a remarkable series of instantaneous photographs exhibiting a new feature in the splash of a rough sphere. This new feature appears when the height of fall is increased beyond a certain critical value. Below the critical height the splash is characterised by an upward jet thrown high into the air. It is now found that when the critical height is passed the long cylindrical column of air which follows the sphere in its descent through the liquid is pierced by a central *downward* jet directed from above along the axis of the air column. This is due to the permanent closing, at an early stage, of the mouth of the air column by a film of the liquid, and to the subsequent reduction of the pressure of the confined air through the piston-like action of the sphere when its momentum is large enough. The morning's proceedings concluded with a paper by Prof. F. T. Trouton on the analogy between adsorption from solutions and aqueous condensation on surfaces. When cellulose is inserted into the solution of a dye adsorption takes place, the amount of which depends upon the concentration and the temperature, but the amount can be kept at any particular value by simultaneously varying both. When such corresponding values of concentration and temperature are plotted against one another the curves are similar to one another, and, further, they are similar to the ordinary saturation curve for the solute in question. This result is analogous to the law of the temperature isoneres for water vapour when we substitute osmotic pressure for concentration and the saturation curve of the solution for the boiling-point curve, viz. that at different temperatures the pressure ordinate of a given isonere is a constant fraction of the corresponding ordinate of the boiling-point curve. Thermodynamical considerations were given in favour of both results.

On resuming the sitting in the afternoon a paper by Dr. J. A. Harker and Mr. F. P. Sexton was read (by the former), on the effect of pressure on the boiling point of sulphur. The results are closely represented by the formula

$$T = T_s + 0{\cdot}0904\,(p - 760) - 0{\cdot}0000519\,(p - 760)^2,$$

where T is the temperature of the vapour on the air-scale at the pressure p in mm., and T_s is the normal boiling point. This gives a result much greater than the value 0·082 mm. per degree which is usually employed, and which is based on Regnault's observations.

Dr. Glazebrook then communicated a paper on the photometric standard of the National Physical Laboratory. Wet- and dry-bulb thermometers are found to give results 20 per cent. higher for the humidity of the air than hygrometers of the Assman pattern, which are used at the Reichsanstalt. The former were used at the National Physical Laboratory in connection with the effect of humidity on the pentane lamp. It is proposed to change the standard humidity from 10 to 8 litres per cubic metre, and thereby maintain the light value unchanged.

A paper by Mr. John Brown, on a dry Daniell pile, was taken as read in the absence of the author.

Meanwhile, the department of cosmical physics had been meeting, the first paper being by Sir John Moore, on the question, Is our climate changing? The object of the paper was to test the accuracy of the popular opinion that there is a progressive postponement of season, an opinion strengthened by occasional abnormal weather conditions, such as the snow and frost at the end of April, 1908, and the summer heat at the beginning of September, 1906. From an examination of old records and of the long series of observations made at Greenwich, the conclusion was drawn that no appreciable change has taken place in our climate during the past six centuries.

Dr. Shaw pointed out as instances of progressive changes bearing on this question the gradual receding of glaciers and of the Antarctic ice barrier, which had lost thirty miles in ten years.

Commander Campbell Hepworth, C.B., of the Meteorological Office, read a paper on the changes in the temperature of the North Atlantic and the strength of the trade winds. The N.E. trade wind is strongest in April (13·5 miles per hour) and weakest in September (7·4 miles per hour). The S.E. trade wind is strongest in February (15·5 miles per hour) and weakest in May (13·7 miles per hour).

The surface temperature was lowest in March and highest in August.

There appears to be a relation between the departures from mean velocity in the trade winds in one year and the departures from mean temperature in the surface waters in the succeeding year.

A paper by Mr. F. J. M. Stratton, on the constants of the lunar libration, described how a re-investigation of the heliometer observations of Mösting A made by Schlüter at Königsberg in the years 1841–3 has been undertaken in the hope of reconciling the conflicting sets of constants given by Drs. Franz and Hayn.

Mr. W. Makower, Miss Margaret White, and Mr. E. Marsden contributed the results of observations on the electrical state of the upper atmosphere. The current down a kite wire when the kite is at an altitude of 1500 metres is of the order of 2×10^{-4} amperes. It increases with the height more quickly than according to the linear law, and varies in a more or less regular way with the wind velocity.

On Tuesday, September 8, the section was also divided into three parts. In the mathematical department two papers were contributed by Prof. A. W. Conway. In the first—application of quaternions to problems of physical optics—Prof. Conway showed how the analytical treatment of such problems becomes both simpler and more elegant when they are expressed in quaternion notation. As examples he worked out the problem of reflection and refraction at a plane surface, showing how to obtain the ratio of the intensities; and also that of the propagation of light through a rotationally active medium such as a sugar solution.

Prof. Conway's second paper dealt with the distribution of electricity in a moving sphere. The sphere was assumed of invariable form, and its velocity less than the velocity of light. In the discussion which followed, Prof. Conway mentioned that Mr. Varley had recently found that a point of inflection in the curve of mass to velocity was indicated by experiment, and no theory could be entirely satisfactory which did not show such an effect.

Major P. A. MacMahon read a paper on a problem known as that of the "Scrutin de Ballotage." This problem relates to the probability that when two candidates are up for election, the candidate finally successful shall be throughout at the top of the poll. Major MacMahon has generalised this by considering an election where there are any number of candidates, and has found the probability that at any time during the election the candidates shall be in the same order as they are finally.

Prof. R. W. Genese followed with a paper on the analysis of projection. He showed that if the vanishing lines of two figures in space perspective be taken as axes of y, Y respectively, and the lines where the planes of the two figures are met by a plane through the vertex of projection perpendicular to both as axes of x, X respectively, then the coordinates are connected by the relations

$$\frac{y}{Y} = \frac{x}{Z} = \frac{z}{X},$$

z, Z being constants, which may be taken as unity, and the curve $y = f(x)$ in one plane transforms into the curve $y = xf(1/x)$ in the other.

Mr. H. Bateman then explained a method of obtaining solutions of problems in geometrical optics by conformal transformations in space of four dimensions. He showed that for such transformations (of which inversion is an important particular case) the equations

$$\left(\frac{\partial V}{\partial x}\right)^2 + \left(\frac{\partial V}{\partial y}\right)^2 + \left(\frac{\partial V}{\partial z}\right)^2 + \left(\frac{\partial V}{\partial w}\right)^2 = 0,$$

and

$$\frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2} + \frac{\partial^2 V}{\partial w^2} = 0,$$

are invariant, and consequently from any one solution of such equations a new solution can be at once deduced.

Mr. Bateman also pointed out that the twenty-four known transformations of the hypergeometric equation into itself arise naturally from the consideration of rotations in four-dimensional space.

Prof. Purser read a paper on motion of solids in an incompressible fluid, and discussed the validity of the application of Lagrange's equations of motion to such a case.

Prof. E. T. Whittaker, in a communication entitled "The Extension of Optical Ideas to the General Electromagnetic Field," showed that the disturbances of the æther could be expressed in terms of two functions, F, G, as follows:—

$$\text{Electric vector} = \left(-\frac{\partial^2 F}{\partial y \partial t}+\frac{\partial^2 G}{\partial x \partial z},\ \frac{\partial^2 F}{\partial x \partial t}+\frac{\partial^2 G}{\partial y \partial z},\ \frac{\partial^2 G}{\partial z^2}-\frac{1}{c^2}\frac{\partial^2 G}{\partial t^2}\right).$$

$$\text{Magnetic vector} = \left(\frac{\partial^2 G}{\partial y \partial t}+\frac{\partial^2 F}{\partial x \partial z},\ -\frac{\partial^2 G}{\partial x \partial t}+\frac{\partial^2 F}{\partial y \partial z},\ \frac{\partial^2 F}{\partial z^2}-\frac{1}{c^2}\frac{\partial^2 F}{\partial t^2}\right),$$

c being the velocity of light, and F, G solutions of Laplace's equation of degree zero. Prof. Whittaker suggested that these functions, F, G, might be taken as two scalars defining the state of the æther in the same way that temperature and pressure define the state of a gas.

The general physics department on this day began with a suggestion with regard to the meaning of valency, by Mr. H. Bateman. In this paper the valency of an atom is identified with the number of degrees of freedom of certain displacements. A molecule has lost all these degrees. A single atom or a cluster which still possesses "valency" degrees of freedom may be regarded as an ion. A scheme representing geometrically a sequence of processes which possess some of the features exhibited by those taking place within the atom was based on the theory of inversion. A transformation of a specified type by inversion with respect to two spheres was shown to depend on eight parameters, a fact which may be of significance in regard to eight being the maximum valency of an atom. Prof. Rutherford congratulated the author, but pointed out that it had not yet been shown that such a transformation by inversion could take place physically. In response to a question by the chairman (Prof. C. H. Lees), Mr. Bateman stated that, for an atom such as he pictured, if the state of motion is not steady the spectral lines would not be sharp; otherwise they would be sharp. After any disturbance the spectrum at first produced would be a continuous spectrum.

Prof. J. A. McClelland followed with an important summary of our present knowledge of secondary radiation. It is unfortunate that it is not possible to further summarise it in the few words available in these columns. In the discussion, Prof. J. C. McClennan insisted that it is necessary to determine the velocities and to employ the magnetic field more before the various effects will be disentangled.

Then Prof. E. Rutherford gave the conclusions from his recent experiments on the scintillations of zinc sulphide (as in the spinthariscope). The effect he believes to be due, in the first place, to a chemical dissociation of the sulphide, and the light is due either to this or to the subsequent re-combination. Thus he dissociates himself from the view that it is the result of merely mechanical bombardment. He has measured the luminosity of the sulphide screen when exposed to emanation from 200 milligrams of radium, and finds that 80 per cent. of the energy of the α particles is transformed into light; about 1/50th to 1/100th of a candle-power is obtainable.

Mr. H. H. Poole described a determination of the rate of evolution of heat by pitchblende. The experiment, which seems to have been made with great care, gave about twice the quantity estimated from the known amount of radium present. Prof. Rutherford was of opinion that possibly a small amount of chemical heating may be present.

Mr. T. Royds, working in Prof. Rutherford's laboratory, described his measurements of the grating spectrum of radium emanation. The error in the wave-lengths of the grating photographs is not more than about 0·1 Ångström unit. Prof. Dewar mentioned that the lines published in NATURE agree closely with lines given by himself and Liveing obtained from less volatile constituents of air. The agreement was possibly accidental, but it was well worthy of being tested.

Photographs were next shown, by Dr. W. G. Duffield, of the arc spectra of metals under pressure; these include those of iron and copper under pressures up to 101 atmospheres, and that of silver up to 121 atmospheres.

Mr. H. Stansfield followed with a paper on secondary effects in the echelon spectroscope. These effects arise from repeated reflection from the plates, as in the Fabry and Perot interferometer, and would, if alone, consist of rings; but they are superposed upon the ordinary echelon spectra. By raising one end of the echelon and using screens, the secondary effects can be separated and used alone. The resolving power is much greater than if the secondary effects were absent.

In the cosmical physics department a paper was read by Dr. G. A. Hemsalech on new methods of obtaining the spectra in flames. A special burner is fed with air, which becomes laden with metallic vapour by passing through a bulb containing a spark discharge. Investigation of the iron spectrum showed that the *lowest* temperature flame spectrum consisted of "enhanced" and "polar" lines. Dr. W. G. Duffield welcomed Hemsalech and de Wattville's researches as overthrowing the "temperature" hypothesis of the origin of "polar" lines. Prof. Larmor indicated that the criterion for the production of spectra was not temperature, but the acceleration of the vibrating systems. Sir O. Lodge concurred. Dr. James Barnes stated that he found that the 4481 Mg line appeared as a polar line in the arc spectrum of that metal.

Prof. J. Larmor then showed Dr. G. E. Hale's recent photographs of the spectra of sun-spots taken through polarising apparatus, in which the centres of some lines are shifted relatively to their normal position, the direction of shift being changed by rotating the polariser through 90° (see NATURE and *Astrophysical Journal*, September). The effect is attributed to the magnetic field arising from vortices of charged particles. The bearing upon the phenomenon of the depth from which the light was emitted was discussed. It is a pity that the pressure of papers prevented a discussion on these important photographs from taking place.

A paper by the Rev. A. L. Cortie, S.J., brought forward evidence of the possible existence of steam in the region of sun-spots. In a paper by Prof. Whittaker on sun-spots and solar temperature, the possibility of the existence of compounds in the sun was discussed, and it was shown that pressure may be a more powerful agent in preventing dissociation than temperature is in producing it, and the characteristics of spot spectra may be due to the high pressure.

Mr. E. M. Wedderburn, in a paper on the causes of seiches, brought forward evidence that their most effective cause was a series of atmospheric oscillations nearly coincident in period with them.

M. Teisserenc de Bort read a paper on the difference of temperature of the upper atmosphere in polar and in equatorial regions. At a height of 10 or 11 kilometres there is no difference of temperature in the two regions. Above this height, the arctic temperature keeps constant, while the equatorial continues to decrease. Mr. W. A. Harwood contributed a note on the *ballons-sondes* ascents made at Manchester during 1907–8, which confirm the existence of the isothermal layer.

Mr. J. S. Dines exhibited diagrams showing the results of the *ballons-sondes* ascents made in the international week, July 27 to August 1, 1908.

Captain H. G. Lyons gave the results of observations of upper-air currents in Egypt and the Sudan. Mr. R. G. K. Lempfert, of the Meteorological Office, exhibited a zoetropic apparatus for showing the manner in which cyclonic disturbances move across the British Isles, and the way in which the air circulates. Mr. Paul Durandin read a paper on an asymmetry in cyclones, in which he pointed out that thunderstorms and tornadoes occur generally on the right-hand side of the path of the centre of the large depression with which they are associated.

On Wednesday, September 9, the section sat in single session.

Mr. T. L. Bennett read, on behalf of Mr. J. I. Craig, a paper on the changes of atmospheric density in storms.

The chief results arrived at were that the time-change of density is negative in the front of cyclones and positive in the rear, that the changes are greater in the front quadrant to the right of the path than in the front quadrant to the left, in which, however, the largest rainfall occurs. From an application of the equation of continuity, the vertical velocity of the air in a moving cyclone was deduced.

Dr. Shaw read a paper on the meteorology of the winter quarters of the *Discovery*. He showed a slide of a relief-map of the district in which the *Discovery* spent the years 1902 and 1903, directing attention to the proximity of Mt. Erebus, the cloud from which enabled the observers to determine the upper-air currents. Some surprise was caused by the statement that the annual amount of bright sunshine at this place was as large as that for Scilly. The wind observations corroborated the theory that had been formed regarding the general circulation of the atmosphere in polar regions, *i.e.* an easterly surface wind with a westerly current in the upper air.

Mr. Bernacchi read a paper which was chiefly concerned with the results of the magnetic observations taken during the *Discovery's* sojourn in the Antarctic regions.

The Rev. H. V. Gill, S.J., read a paper on earthquakes and waves in distant localities. An earthquake at one place may cause the premature occurrence of an earthquake at another place. This precipitation is possibly due to the slight change in the distribution of the earth's mass relative to its axis of rotation, caused by the water disturbance accompanying the earthquake.

Dr. Shaw exhibited diagrams illustrating the storm of August 31 to September 1, the B.A. storm of 1908. The diagrams were collected from stations in connection with the Meteorological Office, and showed how the fury of the storm concentrated itself on the line from Holyhead to Kingstown.

Miss C. O. Stevens read a paper on the great snowstorm of April 25.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following is the speech delivered by the Public Orator, Dr. Sandys, on Thursday, October 29, in presenting for the complete degree of Master of Arts *honoris causa* Prof. W. J. Pope, Dr. Liveing's successor in the chair of chemistry:—

Viri in Academiam nostram liberalissimi, viri Scientiarum Doctoris nuper honoris causa merito creati, cathedram vacuam relictam occupat hodie vir inter Londinienses natus atque educatus, vir non modo inter Londinienses sed etiam inter Mancunienses scientiam chemicam praeclare professus. Peritis nota sunt opera eius plurima de scientiae illius provincia organica (ut aiunt), deque metallis et crystallis praesertim conscripta. Quae autem ratio intercedat inter corporum naturam pellucidam et primordiorum e quibus corpora illa constent dispositionem, primus omnium (nisi fallor) detexit, et sulphuris, selenii, stanni praesertim in particulis inaequaliter distributis luculenter illustravit. Hodie vero nobis vix necesse est haec omnia subtilius persequi. Satis in hunc diem erit, si professori nostro novo munus suum feliciter auspicato omnia prospera ex animo exoptamus.

Mr. A. R. Hinks has been appointed Royal Geographical Society university lecturer in surveying and cartography, for three years as from Michaelmas, 1908.

Dr. Marett Tims will give a course of ten lectures on the morphology of teeth in the Vertebrata during the present term. The first lecture will be in the laboratory for advanced zoology on Saturday, November 7.

THE Royal University of Ireland has conferred the degree of D.Sc. *honoris causa* on Prof. Alfred Senier, of Queen's College, Galway, in recognition of his services as a teacher of chemistry in Galway and of his discoveries in organic chemistry, notably his work on acridines.

THE Right Hon. Earl Carrington, President of the Board of Agriculture, will open the Edric Hall and new workshops of the Borough Polytechnic Institute on Friday, November 13. This extension of the institute is primarily due to the gift of 5000*l.* by the first chairman of the governing body, Mr. Edric Bayley, which has been supplemented by grants from the London County Council amounting to about 10,000*l.*

AN address on the correlation of the teaching of mathematics and science will be given by Prof. J. Perry, F.R.S., at a conference of the Mathematical Association and the Federated Associations of London Non-Primary Teachers to be held at the Polytechnic, Regent Street, on Saturday, November 28, at 3 p.m. The chair will be taken by Prof. G. H. Bryan, F.R.S., president of the Mathematical Association. Tickets of admission to the conference can be obtained from Mr. P. Abbott, 5 West View, Highgate Hill, N.

THE annual report of the treasurer of Yale University for the financial year ending June 30 shows additions to the funds of the University during the year of 253,000*l.* The principal items are 12,600*l.* from the Yale alumni fund; from the Archibald Henry Blount bequest, 67,400*l.*; from the Lura Currier bequest, 20,000*l.*; by bequest of D. Willis James, 19,000*l.*; from contributions to the University endowment and extension fund, 67,100*l.*; and from balance of the Ross library fund, 22,400*l.* Gifts to income amounted to 15,300*l.*, of which 6000*l.* came from the Alumni Fund Association.

THE winter session of the Crown School of Forestry opened on November 2. This little-known institution has its headquarters at Parkend, a small village in the Royal Forest of Dean. In a small shed, rough, unpainted, scarcely weather-proof, sixteen students receive instruction in the theoretical aspect of forestry, and in the surrounding forest they study the practical part of the subject. A nursery plot—two acres in extent—has been cleared, and an enclosure of nearly 200 acres will shortly be set apart for experimental work. The director of the school, Mr. C. O. Hanson, late of the Indian Forest Service, makes up in personal enthusiasm what is lacking in the equipment of the school, and so successful has been the work that the Department of Woods and Forests is spending a considerable sum on the equipment of a new building to accommodate the school.

DR. H. T. BOVEY, F.R.S., Rector of the Imperial College of Science and Technology, in his recent address (NATURE, October 15, p. 616) recommended the formation of associations of alumni by the constituent colleges, and directed attention to the American method of appointing a secretary each year whose office it is to keep in touch with the students who passed out in his year. Dr. E. F. Armstrong writes to point out that the Central Technical College—which is now a constituent institution of the Imperial College—has had an "Old Students' Association" since 1897, which is kept in touch with its members much in the way that Dr. Bovey advocates. It issues an illustrated journal, *The Central*, in which the doings of past students are regularly recorded; it also administers a successful employment agency bureau. The contributions to this periodical have frequently been mentioned in NATURE. Dr. Armstrong also states that a year ago the Old Centralians collected the funds to found a scholarship as a permanent memorial to the long connection of Prof. W. C. Unwin, F.R.S., with their college.

IN a lecture before the Fabian Society on October 28, Prof. M. E. Sadler said that the chief points at which, under present conditions in England, the State should aim, were:—(1) a great reduction in the size of the large classes in many public elementary schools, in order that the teachers might be able to give more individual care to the different pupils; (2) careful medical inspection, at sufficiently frequent intervals, of all school children with the view of securing the due physical development of the rising generation, parental duty in the care of children to be stringently enforced, with liberal aid in cases of

need; (3) generous provision of playgrounds, under skilful supervision, with the view of encouraging a healthy corporate life in all schools; (4) the raising, at dates to be fixed by Parliament, of the present age of exemption from school attendance throughout the country (with a possible reservation of the agricultural districts), first to thirteen and then to fourteen years of age; (5) the abolition by statute of the half-time system in the textile districts; (6) the provision of various forms of educational care for young people during the critical years of adolescence; (7) the laying upon all employers of a statutory obligation to enable their younger workpeople, up to seventeen years of age, to attend courses of suitable instruction, provided or approved by the local authority of the district, and held at a time of day which would prevent those attending the classes from suffering from overstrain of body or of mind.

A MEETING of the Child Study Society was held on October 29, when a paper was read by Miss Alice Ravenhill on the results of an investigation into hours of sleep among elementary-school children. For nearly three years Miss Ravenhill has been collecting information on the question of the quantity of sleep secured by children in English elementary schools. Of 10,000 forms issued, 6,180 were properly filled up, and gave particulars as to 3500 boys and 2680 girls. A comparison between the standard hours of sleep as defined by the best authorities and an average struck from the whole of the material at command shows a deficiency of from $3\frac{1}{4}$ to $2\frac{3}{4}$ hours at each age period, a loss equivalent to one night in four among the youngest and eldest children, and to one night in five among those of intermediate ages. For example, at ages three to five years the average is 10·75 hours, against a standard of fourteen hours, and, at thirteen years, eight hours, against 10·75 hours. The evil of insufficient sleep is widespread. Parents must be roused to a sense of the importance of the subject, and the enforcement of the laws on the employment of children should be rendered obligatory upon local authorities. Sir James Crichton-Browne, who presided, emphasised the need of sufficient sleep, and pointed out that sleep repairs waste in every organ of the body, and stores oxygen in the tissues as a reserve fund against the needs of the following day.

THE Board of Education has decided to introduce a new system of organisation for the Victoria and Albert Museum. Re-organisation of the administrative arrangements for the museum has been rendered necessary by the transfer of the technological branch of the Board of Education from South Kensington to Whitehall. Hitherto the administration of the museum has been supervised and controlled by the principal assistant secretary in charge of that branch of the Board's office, and the removal of that branch to Whitehall renders the continuance of that arrangement impossible at so great a distance from South Kensington. In consequence of this transfer the Board decided to take the opportunity of placing the museum on an independent basis, equipped with the necessary administrative as well as technical machinery and staff. A new post has therefore been established under the title of "Director and Secretary of the Art Museum," the holder of which will, in future, be directly responsible to the Board, with assistance from the advisory council, for the whole administration of the museum and for the working of its staff. To this post the President of the Board has appointed Mr. Cecil H. Smith, of the British Museum. Mr. A. B. Skinner will take charge of a new department of architecture and sculpture to be created in the museum. It has been decided to classify the collections as far as possible by materials, and to constitute the following eight departments:—(1) architecture (original architectural objects and sculpture); (2) metalwork; (3) woodwork and leatherwork; (4) textiles; (5) ceramics, enamels, and glass; (6) engraving, illustration, and design; (7) the library; (8) pictures. Arrangements have further been made in the new and old buildings of the museum by which the staff attached to each of the eight departments will be provided with suitable offices in close proximity to the collections respectively under their charge.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 25.—"The Emission and Transmission of Röntgen Rays." By G. W. C. **Kaye**.

The Röntgen rays produced by some twenty elements used as anti-kathodes were investigated.

(1) The relative intensities of the radiations, when unobstructed by any screen, do not follow the order of the atomic weights of the anti-kathodes.

(2) If the different radiations are cut down by screens of increasing thickness, the intensities reach ultimate relative values which are not altered by a further increase in the thickness of the screen: thus at this stage all the radiations have the same hardness. These intensities are very approximately proportional to the atomic weights of the radiators. The relative values of the heavy-atom metals increase somewhat with a rise in potential on the tube.

(3) When screen and radiator are of the same metal, selective transmission of the radiation is manifested, that is, the radiation from the metal is augmented relative to the radiations from other anti-kathodes. The effect is also present to a less extent when radiator and screen have closely adjoining atomic weights.

(4) This augmentation, when radiator and screen are alike, is most pronounced in the case of the metals of the chromium-zinc group. It is least marked for a substance of low atomic weight.

(5) When screen and radiator are alike, the absorption per unit mass of unit area of the screen is relatively low. Benoist's "transparency" curve is much straighter for a radiator of aluminium than for one of platinum working under the same conditions. With an anti-kathode belonging to the chromium-zinc group the curve has to be modified by the addition of a sharp maximum in the neighbourhood of the radiator.

(6) The question of the anomalous results obtained with the secondary radiation from nickel is gone into.

(7) The curve of transmission in which the thickness of screen is plotted as abscissa against the logarithm of the intensity consists of three parts when radiator and screen are of the same metal. First, with thin screens, there is a relatively steep portion, which for thicker screens is followed by a straight-line region indicative of an exponential absorption; this again is ultimately succeeded by a region in which the slope gradually diminishes with the thickness of the screen. The preliminary steepness is attributed to secondary radiation; the ultimate flattening of the curve is probably due to scattering of hard primary rays. If the potential on the tube is not very high the absorption curve indicates homogeneity throughout its length.

(8) When screen and radiator have very different atomic weights, the region of exponential absorption does not appear.

Received August 6.—"The Rate of Production of Helium from Radium." By Sir James **Dewar**, F.R.S.

Some time ago the author communicated a paper to the society entitled "Note on the Use of the Radiometer in observing Small Gas Pressures: Application to the Detection of the Gaseous Products produced by Radio-active Bodies" (Roy. Soc. Proc., A, vol. lxxix., p. 529, 1907). In the course of the experiments recorded in that paper it was shown that a pressure of the fifty-millionth of an atmosphere could easily be detected by radiometer motion, and that the helium produced by radio-active processes from some 10 milligrams of bromide of radium could be definitely detected after a few hours. This led the author to desire some direct measurements of the amount of helium produced by radium, and through the kindness of the Royal Society in allowing him the use of some radium chloride belonging to them, he is able to give a condensed abstract of the experimental results so far obtained.

The salt employed was the 70 milligrams of radium chloride prepared by Dr. T. E. Thorpe, F.R.S., for his determination of the atomic weight of radium, the preparation of which is fully described in Roy. Soc. Proc., vol. lxxx., p. 298.

The apparatus used for the measurements was a McLeod

gauge, in the construction of which no india-rubber joints were used, the mercury reservoir being connected to an exhaust pump, while the elevation and lowering of the mercury was carried out by admitting and exhausting air in the reservoir. The air coming in contact with the mercury was purified by passage over stick-potash and phosphoric anhydride. Sealed on to the gauge was a long U-tube containing a $\frac{1}{4}$ gram of cocoa-nut charcoal placed in a small enlargement at the bend, the whole being arranged for liquid air or other cooling for any desired length of time. The object of the use of this cooled charcoal is to take up and condense all adventitious gases, other than hydrogen or helium, which might arise from minute leakage or otherwise be generated in the apparatus.

Starting with an exhaustion of 0·000054 mm. in 1100 hours, apart from intermediate irregularities, the total quantity of permanent gas produced per gram of radium per day did not exceed 0·42 cubic mm. As in this experiment the emanation had free play over the whole surface of the McLeod gauge during a fortnight when the laboratory was closed, a second one was carried out, keeping the charcoal U-tube in liquid air during the whole course of the observations, which lasted six weeks. It was now found that, with the exception of the occlusion of the helium in the radium salt and its immediate surroundings, all the anomalies of the first experiment had disappeared, and the steady increment of helium (as shown by the graphical diagram given in the paper) amounted to 0·37 cubic mm. The spectroscopic examination of the gas showed that the helium was pure, and this result was confirmed by observing the reduction in pressure caused by cooling the radium salt and also the charcoal in liquid hydrogen.

The author is not aware of any previous direct measurements of the rate of production of helium from radium, but in a paper on "Some Properties of Radium Emanation," by A. J. Cameron and Sir William Ramsay (Chem. Soc. Jour., 1907, p. 1274), the ratio of the amount of helium produced to that of the emanation was found to be 3·18, and as the amount of the emanation found by them was about 1 cubic mm. per gram of radium per day, the resulting helium, according to this experiment, ought to reach about 3 cubic mm., or at least eight times the rate of production found in the above experiments. The author is at a loss to explain the origin of such grave discrepancies in the measured amount of the helium produced by radium.[1] On the other hand, Prof. Rutherford, in his work entitled "Radio-active Transformations," 1906, p. 186, on the theoretical assumption that the α particle is an atom of helium carrying twice the ionic charge, deduced from electrical measurements that the number of particles expelled per year per gram of radium would reach 4×10^{18}, and as 1 c.c. of a gas at standard temperature and pressure contains $3{\cdot}6\times10^{19}$ molecules, the volume of helium produced per year would amount to 0·11 c.c., which is equivalent to about 0·3 of a cubic mm. per day. Considering that the author has found a rate of helium production of the order of 0·37 cubic mm., the agreement between experiment and the theoretical prophecy of Rutherford is almost too wonderful, substantiating as it does the accuracy of the theory of radio-active changes he has done so much to initiate and develop.

[1] Prof. Rutherford, in a paper, "Experiments with Radium Emanation." Phil. Mag., July, 1908, shows this result is at least ten times too great, his value being of the order 0·11 cub. mm. of emanation per day, whereas from the author's experiments the rate of helium production is just three times this amount.

PARIS.

Academy of Sciences, October 26.—M. Bouchard in the chair. Observations of the comet 1908*c* made at the Observatory of Bordeaux with the 38 cm. equatorial: Luc **Picart**. The observations were made on the nights of October 7, 10, 12, 13, and 17, the apparent positions of the comet and the positions of the comparison stars being given in tabular form. From October 7 to 18 the comet appeared as a feeble nebulosity, without a nucleus, rendering the determination of its exact position difficult. On October 12 the tail was clearly visible, with a length of about two degrees; on the following night the comet presented its usual form.—Observations of the comet 1908*c* made at the Observatory of Marseilles with the Eichens 26 cm. equatorial: M. **Borrelly**. Details are given of observations made on September 12, 15, 16, 17, and October 2 and 3. The changes in form were studied by means of seven photographs.—A first series of photographs of the Morehouse comet obtained with the large telescope at Meudon: L. **Rabourdin**. These photographs were taken on the nights of October 14, 16, 17, 20, 22, and 23 with the telescope of 1 metre aperture. The photographs do not indicate the complete development of the comet, but show the nucleus and portions of the tail. The central nucleus appears to be surrounded by several envelopes, each having its prolongation on the side opposed to the sun.—A theoretical explanation of the experiments of M. Birkeland: Carl **Störmer**. Four photographs are given showing a wire model representing a kathode bundle under the action of a small magnetic globe.—Contribution to the study of lenses: G. **Maltézos**. A theoretical investigation of the equations between the distances of the lens, supposed spherical, from the first luminous point and its secondary images produced by successive reflections and refractions at the surfaces of the lens.—A monotelephone of great sensitiveness and with its note capable of regulation: Henri **Abraham**. A modification of the Mercadier telephone, in which the soft iron plate is replaced by a strong disc of tempered steel. The Mercadier disc is replaced by a small sheet of iron, just sufficiently large to cover the electromagnet, and this is carried by two parallel steel wires. With a rhythmic current in unison with the proper note of the instrument the sensibility is much greater than with ordinary telephones. The note can be varied at will by altering the tension of the steel wires.—Induction and the probable cause of polar aurora: P. **Villard**.—The magnetic properties of metallic oxygen radicals: P. **Pascal**. A study of the magnetic properties of salts of metals which form both acid and basic oxides.—Mercurous nitrate as a microchemical reagent for arsenic: G. **Denigès**. The arsenic compound is converted into arsenic acid, and drops of this solution submitted to the action of a solution containing 10 grams of crystallised mercurous nitrate, 10 c.c. of nitric acid of specific gravity 1·39, and 100 c.c. of distilled water. Characteristic crystals are produced. The smallest amount of arsenic observable by this method is not stated.—Some oxydase phenomena produced by colloidal iron ferrocyanide: J. **Wolff**.—The action of bromine on ether: monobromaldehyde: Ch. **Mauguin**. Bromine reacts on moist ether in presence of light, considerable quantities of monobromaldehyde being produced. The aldehyde is best isolated by means of the condensation compound formed with urethane, the yield being sufficiently good for the reaction to serve as a good method of preparation of this aldehyde.—New researches on bakanosine: Em. **Bourquelot** and H. **Hérissey**. This glucoside is extracted from a Strychnos called Bakanko by the natives of Majunga, Madagascar. The physical and chemical properties of the pure alkaloid are given, the formula being

$$C_{16}H_{2?}O_8N+H_2O.$$

—The transformations of the chromogenic material of grapes during ripening: J. **Laborde**.—Cedrelopsis: M. **Costantin** and H. **Poisson**.—The preservation of the cocoa-nut: M. **Dybowski**. The present method of treating copra causes serious deterioration owing to the action of micro-organisms on the albumin and fat. It has been found that this can be entirely prevented by treating the copra with gaseous sulphur dioxide.—The Plumulariidæ of the *Challenger* collection: Armand **Billard**.—The mobility and dissemination of infected dust due to the disturbance of dried tuberculous sputum: G. **Küss**. A study of the mode of dissemination of infected dust, produced by slowly drying the sputum of tuberculous patients in the dark under conditions approximating to those which occur in practice. The quantity of infected dust produced is very small compared with the quantity of sputum. When the dust is caused by slight shaking or beating of an infected carpet, these powders are only projected for a short distance above the carpet. They are, however, sufficiently light to remain in suspension in the air for from

ten to fifteen minutes, and during that time can be carried by currents of air about the room.—An infection of the gondi (*Ctenodactylus gondi*) with the Leishman or a similar organism: C. **Nicolle** and L. **Manceaux**.—The preponderating *rôle* of geometry in topographical examinations: M. **Contremoulins**. A discussion of the application of geometrical principles to practical radiography. The author arrives at the following conclusions:—the distance of the radiating focus from the photographic plate should be constant for all radiographic examinations, the normal incidence ought to be inscribed automatically in the course of the examination on the plate, the attitude in which the subject has been radiographed ought to be mentioned on the proof, and, whenever possible, two radiographs should be taken forming two planes of projection at an angle of 90°.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part iii. for 1908, contains the following memoirs communicated to the society:—

May 16.—The formal relations of quadrilaterals composed of circular arcs: W. **Ihlenburg**.—New developments in linear differential equations: E. **Hilb**.—A new method of solution of certain boundary-value problems: W. **Ritz**.—The application of integral equations to the problem of Riemann: E. E. **Levi** (Pisa).

June 27.—The influence of a naturally active body on light reflected from it: K. **Försterling**.—The decomposition of an empirically given periodic function into series of sines: C. **Runge**.—The reduced differential equations of a heavy unsymmetrical top: P. **Stäckel** (Karlsruhe).

July 11.—Researches from the University chemical laboratory of Göttingen, xx. (1) Transformation of nopinone ($C_9N_{14}O$) into β-pinene ($C_{10}H_{16}$), camphene, and camphor ($C_{10}H_{16}O$); (2) the alcohols of the terpinene series; (3) the modifications of terpinene: O. **Wallach**.

July 25.—Formulæ for the reflection of light at a thin metallic film: W. **Voigt**.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 5.

ROYAL SOCIETY, at 4.30.—(1) Note on Tidal Bores; (2) Vortices in Oscillating Liquid: The Lord Rayleigh, O.M., Pres. R.S.—Note on Two recently-compiled Calendars of Papers of the Period 1606–1806 in the Archives of the Royal Society: Prof. A. H. Church, F.R.S.—On the Generation of a Luminous Glow in an Exhausted Receiver moving near an Electrostatic Field, and the Action of a Magnetic Field on the Glow so produced, the Residual Gases being Oxygen, Hydrogen, Neon and Air: Rev. F. J. Jervis-Smith, F.R.S.—The Rate of Production of Helium from Radium: Sir James Dewar, F.R.S.—The Spectrum of Radium Emanation: A. T. Cameron and Sir William Ramsay, K.C.B., F.R.S.—On the Osmotic Pressures of Aqueous Solutions of Calcium Ferrocyanide. Part I., Concentrated Solutions: The Earl of Berkeley, F.R.S., E. G. J. Hartley, and C. V. Burton.—The Effect of Pressure upon Arc Spectra. No. 2, Copper: W. G. Duffield.—On a Method of Comparing Mutual Inductance and Resistance by the Help of Two-phase Alternating Currents: A. Campbell.

CHEMICAL SOCIETY, at 8.30.—The Direct Union of Carbon and Hydrogen: W. A. Bone and H. F. Coward.—The Relation between Absorption Spectra and Chemical Constitution. Part XI., Some Aromatic Hydrocarbons: E. C. C. Baly and W. B. Tuck.—Organic Derivatives of Silicon. Part VII., Synthesis of *dl* Sulphobenzylethylisobutylsilicyl Oxide: B. D. W. Luff and F. S. Kipping.—(1) Chlorine Derivatives of Pyridine. Part IX., Preparation and Orientation of the Dichlor pyridine, m. p. 66–70; (2) Chlorine Derivatives of Pyridine. Part X., Orientation of the Trichloropyridine, m. p. 49–50; (3) Chlorination of Methyl Derivatives of Pyridine. 2-Methyl pyridine. Part II.: W. J. Sell.—(1) The Triazo-group. Part V., Resolution of α-Triazopropionic acid; (2) The Triazo-group. Part VI., Triazoethyl Alcohol and Triazoacetaldehyde: M. O. Forster and H. E. Fierz.

LINNEAN SOCIETY, at 8.—Notes on some Parasitic Copepoda, with a Description of a New Species of *Chondracanthus*: May E. Bainbridge.—On some Nemerteans from the Eastern Indian Ocean: R. C. Punnett and C. Forster Cooper.—Report on the Echinoderms other than Holothurians collected by Mr. Stanley Gardiner in the Western Parts of the Indian Ocean: Prof. F. Jeffrey Bell.

RÖNTGEN SOCIETY, at 8.15.—Presidential Address, The Amsterdam Congress.

FRIDAY, NOVEMBER 6.

GEOLOGISTS' ASSOCIATION, at 8.—On some Norwegian Lakes and Rock-Basins: H. W. Monckton

TUESDAY, NOVEMBER 10.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Glasgow Central Station Extension: D. A. Matheson.

THURSDAY, NOVEMBER 12.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Charges on Ions in Gases, and the Effect of Water Vapour on the Motion of Negative Ions: Prof. J. S. Townsend, F.R.S.—The Charges on Ions produced by Radium: C. E. Haselfoot.—The Occlusion of the Residual Gas and the Fluorescence of the Glass Walls of Crookes's Tubes: A. A. Campbell Swinton.—An Investigation of the Anatomical Structure and Relationships of the Labyrinth in the Reptile, the Bird and the Mammal: Dr. A. A. Gray.—The Natural Mechanism for Evoking the Chemical Secretion of the Stomach (Preliminary Communication): Dr. J. S. Edkins and Miss M. Tweedy.—Furthur Observations on Welwitschia: Prof. H. H. W. Pearson.—On the Presence of Hæmo agglutinins, Hæmo-opsonins and Hæmo-lysins in the Blood obtained from Infectious and Non-Infectious Diseases in Man (Preliminary Communication): L. S. Dudgeon.—Preliminary Note on the Occurrence of a New Variety of Trypanosomiasis in the Island of Zanzibar: A. Edington.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Inaugural address by the President, Mr. W. M. Mordey.

MATHEMATICAL SOCIETY, at 5.30 (*Annual General Meeting*).—On the Theory of Groups of Finite Order (Presidential Address): Prof. W. Burnside.—On the Dirichlet Series and Asymptotic Expansion of Integral Functions of Zero Order: J. E. Littlewood.—The Norm Curves on a Given Base: Prof. F. Morley.—Satellite Curves on a Plane Cubic: J. O'Sullivan.—On the Arithmetical Nature of the Coefficients in a Group of Linear Substitutions (Third Paper): Prof. W. Burnside.—On the Second Mean Value Theorem of Integral Calculus: Dr. E. W. Hobson.—On the Representation of a Function by Means of a Series of Legendre's Functions: Dr. E. W. Hobson.—The Conformal Transformations of a Space of Four Dimensions and their Applications to Geometrical Optics: H. Bateman.—Periodic Properties of Partitions: D. M. Y. Sommerville.—The Solution of Integral Equations: Prof. A. C. Dixon.—The Eliminant of Three Quantics in Two Independent Variables: A. L. Dixon.—A Note on the Continuity or Discontinuity of a Function defined by an Infinite Product: G. H. Hardy.—The Energy and Momentum of an Ellipsoidal Electron: F. B. Pidduck.—On *q*-Integration: Rev. F. H. Jackson.—On *q*-Transformations of Power Series; Rev. F. H. Jackson.—The Complete Solution in Integers of the Eulerian Equation $X^4 + Y^4 = U^4 + V^4$: Dr. T. Stuart.

FRIDAY, NOVEMBER 13.

PHYSICAL SOCIETY, at 8.

MALACOLOGICAL SOCIETY, at 8.—Note on *Diplommatina strubelli*, Smith: E. A. Smith.—The Radulæ of British Helicids, Part ii: Rev. E. W. Bowell.—New Marine Mollusca from New Caledonia, &c.: G. B. Sowerby.—New Species of Macrochlamys and Monocondylæa from Siam: H. B. Preston.—A New Species of Oliva: F. G. Bridgman.

CONTENTS.

THURSDAY, NOVEMBER 12, 1908.

A HISTORY OF THE EARTH.

Geschichte der Erde und des Lebens. By J. Walther Pp. iv+570; with 353 illustrations. (Leipzig: Von Veit and Co., 1908.) Price 14 marks.

PROF. WALTHER'S history of the earth and of life has been written with that combined knowledge of physical geography, stratigraphy, astronomy, and biology which we have learnt to expect from the author's previous writings. He tells the story of the earth in a series of chapters which have the interest of essays instead of the compressed information of a text-book, and are rich in fresh observations made by the author or culled from recent technical literature. The volume is remarkably well illustrated. One feature of the illustrations is the abundance of drawings showing extinct animals reproduced as in life. There are also numerous pictures of ideal landscapes and seascapes, drawn in accordance with most recent knowledge. Such, for example, is the terrifying picture of *Coccosteus decipiens,* by Rudloff, after a reproduction by Jaeckel, the beauty competition between Rhamphorhynchus and Archæopteryx on the shores of the Solenhofen lagoon, and the race between two flying Pteranodons, which, as they had a body weighing only 15 kilograms to a wing span of 18 feet, resemble a modern aëroplane with its small motor and vast sails. The views include pictures of life on the sea floor in two epochs of the Cambrian period, and one of a Calamite forest in the Carboniferous, by Rudloff, from designs by Walther. The illustration of Dinornis is, however, somewhat out of date, as the bird's title to its specific name of maximus is due more to the artist than to nature.

The book begins with a series of chapters on the physics of the earth, which the author describes as composed of five zones. For the central mass he adopts the name of pyrosphere, and to the zones usually accepted he adds the biosphere, which he separates from the underlying lithosphere, owing to the wide area occupied by coral limestones and forests. The author then discusses the relations of the earth to other heavenly bodies, and he enters a welcome and emphatic protest against the continuance of describing the ring-shaped mountains of the moon as volcanoes. He, however, accepts Dr. G. K. Gilbert's theory that they are due to meteoric masses which were fused by collision with the moon and spread out as a ring around the point of impact.

We also welcome his view, which he repeats from his paper of 1903, that the development of the deep oceanic basins began at the close of Palæozoic times, so that the modern abyssal oozes are not to be expected in the Palæozoic rocks. The book includes a map showing the supposed wanderings of the North Pole, and discusses the shifting of the pole as the possible cause of climatic changes; the fact is admitted, however, that this movement of the pole has not been proved for any geological period.

The author also refers to various attempts to express geological time in years, and in this matter does not seem very hopeful of satisfactory results. He quotes estimates of the age of the earth, from the 20 million years of Lord Kelvin to the 100 to 180 million estimate of Sir Archibald Geikie. He caricatures one line of argument by remarking that because one man can build a wall in 100 hours, it does not follow that 360,000 builders could build the same wall in one second. He gives a photograph of a lump of coral 8 centimetres high, which had grown in four years on a telegraph cable, and he argues therefrom that a layer of coral limestone 600 metres thick could have been deposited in 30,000 years, an unconvincing argument, owing to the difference in texture between a branching coral and a massive coral rock.

The section of the work devoted to stratigraphical geology the author calls "Bathrologie," which describes each geological system in reference to its most striking geographical character, such as the great northland of the Old Red Sandstone, the *Productus* Sea of the Carboniferous, the continent of Gondwanaland, the Triassic Sea and its struggle with the northern deserts, the Jurassic Sea, &c.

In his geological classification the author adopts one view which will probably not meet with general acceptance, for he groups together the Algonkian and the Cambrian as one group, the Urzeit; the systems from the Silurian to the Permian inclusive he calls the Alt-zeit. Considering the great unconformity and complete palæontological difference between the Algonkian and the Cambrian, and the uncertainty as to the dividing-line between the Cambrian and the Ordovician, the separation of the Cambrian from the rest of the Palæozoic is unnecessary.

In his interesting chapter on prehistoric man the author figures some eoliths from the Miocene; he regards these stones as showing artificial workmanship, and remarks that they have not been found associated with broken bones or any other signs of the contemporary existence of man. The author is probably only logical in his conclusion that, if the eoliths are of human origin, then the age of man must be extended back at least to the Miocene, and probably to even much earlier geological periods.

One mistake may be noted, as it has occurred in other text-books. On p. 132 it is stated that the Pink and White Terraces of New Zealand were destroyed by an earthquake, whereas they were blown to fragments by a volcanic explosion that left a vast crater deep below their site. J. W. G.

SCIENCE AND THE DAILY PRESS.

From an Easy Chair. By Sir E. Ray Lankester, K.C.B., F.R.S. Pp. viii+144. (London: A. Constable and Co., Ltd., 1908.) Price 1s. net.

SCIENCE renders the people a three-fold service. The increase in material comfort and in facility of communication which have resulted from ability to direct the forces of nature have been sufficiently proclaimed by public speakers and acclaimed by their hearers. It is less clear that the public recognise the

more important service rendered by the army of trained men of science, which wages ceaseless war against pestilence, flood, and famine. The scouts of this army penetrate the unknown, under conditions making no small demands on their courage, and render possible the advance of humanity. But even if sufficient regard be paid by the ordinary intelligent citizen to the material service done him by science, it can hardly be denied that he has no conception of his indebtedness on the intellectual and moral side. Yet scientific method, whenever and wherever made welcome, has imparted greater freedom and clearness of thought, has widened imagination and sympathy, and has led to a truer perception of life and character based upon concepts of law and order. Nor need we regard as a small matter the sum of intellectual enjoyment and stimulus derived from the progress of discovery. This progress would be quickened if the people met the demand of science for intelligent sympathy with its aims and methods; for active and liberal support of investigation; for national and personal action in respectful accord with the results established by investigators accredited by their fellow-workers.

But even the material benefits can be reaped to the full only by a nation prepared to recognise the truth expressed on p. 29 of Sir Ray Lankester's book:—

"Science is no handmaiden, but in reality the master—the master who must be obeyed. The sooner and the more thoroughly the people of this country recognise this fact, and insist upon its acceptance in practice by their representatives and governors, the better for them and their posterity."

To the present writer it appears that our fitness to remain at the head of a great empire depends upon our power to "recognise this fact."

Have we this power to-day? We have not; we must seek it through the intelligent sympathy of the people. The publication of this little book suggests one means—a powerful one—to our end, viz. the publication in the daily newspapers of information and articles of a truly scientific character. These articles or notes must be written by men of wide scientific knowledge and high attainments, in order that they may be accurate and reflect truly the aims, methods and results of scientific work.

In his preface Sir Ray Lankester explains that his book is a reproduction of articles which appeared in the *Daily Telegraph* from October, 1907, to April, 1908. The author's style is clear and animated, well adapted to arrest and hold the attention of the newspaper reader. The articles relating to tropical diseases, the public estimate of the value of science, heredity, ignorance, and vivisection display a power and earnestness suited to their themes. The lighter articles convey a considerable amount of information in a chatty, reminiscent style, interspersed with biographical detail. The bit of autobiography on p. 59 is a charmingly told illustration of the experimental method. When discussing votes for women our author is less illuminating, and is perhaps as likely to make opponents as converts. We are glad that he did not confine himself to biological subjects. He concludes an effective short statement of the problems connected with the orientation of ancient temples by a remark on Stonehenge which will be echoed by readers of NATURE:—

"The delay in examining everything on the spot and in making all that remains absolutely secure is a national disgrace."

We hope that the present volume will have many successors.

With the exception of Sir Ray Lankester's work and certain technical articles, the "scientific" paragraphs which we have read in the daily Press are far from reaching the standard which we have already indicated (or the standard reached, *e.g.*, in the case of musical criticism). Too frequently they fall to the level of burlesque absurdity—stuff which no editor would dream of publishing as serious information in regard to any other department of news. In addition to hearing the professor talk "from an easy chair," we want accurate statements of recent advances, as clear and simple as possible, relying for interest on intrinsic importance and not on "popular" dressing and sensationalism. Nor would such "news from the front" of the progress of our scientific army lack appreciative readers. The spread of scientific teaching in our schools and universities, the existence of fifty thousand members of our polytechnics, and, above all, the attention to scientific inventions which is a necessity to organisers of commercial and industrial undertakings—these guarantee the existence of a reading public able to appreciate such scientific information. Surely the time is ripe for the editors of our "dailies" to take science seriously. To find and harness a Huxley and a Helmholtz may be beyond editorial power, but it is within that power to employ men of high scientific training and to require from them contributions of first-rate quality. By so doing they would give an impulse to national progress in science. G. F. D.

THE GREAT PYRAMID.

The Great Pyramid of Gizeh; its Riddle Read, its Secret Metrology Fully Revealed as the Origin of British Measures. By M. W. H. Lombe Brooke. Pp. 217. (London: Banks and Son, 1908.) Price 7s. 6*d*. net.

THE mind of the gnostic is ever with us; it delights in founding the most far-reaching statements upon a basis of facts and dogmas which may or may not be true, but the relevance of which to the conclusion escapes the ordinary intellect. In this volume of 217 pages we have some fresh theories based on older ones about the Great Pyramid, but with a wide departure in results from those of the earlier theorists. Whatever we may conclude about the theoretical results of the late Prof. Piazzi Smyth, we all know that he was able to handle his material in a scientific fashion. This is far from the case in the present volume.

As examples of method we have (p. 29) a sto[ne] of most extreme irregularity—a natural boulder sur[face]—stated to nine places of figures in its cubic

contents; a thickness of stone doubled (for no reason) and multiplied by the power or logarithm of another quantity to get a lineal quantity; a series of different breadths in inches added together (p. 178) ×10, compared with the number of theoretic pounds in a theoretic ton; or the number of lineal inches in a dimension (p. 187) shown to be the same as the number of grains in a theoretic cubic inch of an arbitrary specific gravity. No rational sense can be attached to such processes; they are numerical coincidences, and can have no meaning. When a very large number of quantities, of multipliers, and of processes of connection can thus be handled, and a wide latitude is allowed for the exactitude of the results, there is no reason for the product ceasing at 217 pages; it might as easily be continued to infinity.

The starting point is the boss of granite—one of the well-known lugs for stone lifting, the remains of many of which may be seen on other stones in the pyramid. The dimensions of this vary from 4·7 to 5·2 inches wide, and 0·94 to 1·1 inches thick, the faces being roughly hammer-dressed. This is then assumed to be exactly five inches wide and an inch thick. It is then assumed that at its junction with the stone face it is 7×5 inches; though rounded at the top, it is assumed to be rectangular, and an assumed unit of thirty-five cubic inches is deduced, and then used as a basis for pages of subsequent theory. Any one of the certainly wrong assumptions that are made would leave the conclusion entirely in air. But it serves as an efficient basis for an elaborate gnosis, interesting as a revelation of mental method.

Matters unknown to the author are also elaborated. We read of "those most exact and artistically prepared corner sockets," which are really vague and irregular in every part except the truly flat floor. The cubic content of a socket, which is sunk in a wavy, irregular surface of natural rock, is calculated, and, ÷2, the cubic inches equal the lineal inches in a theoretic mile. The faces of the pyramid are assumed to be concave in order to fill up the corners of the rock-cut sockets, and many pages of theory result from this assumption; yet at the north-east corner the drawn line of the base can be seen running some inches within the side of the socket, showing that the face was straight.

Not only does such wishing serve instead of facts to the gnostic mind, but it may entirely obliterate facts. We read, p. 17, of "the introduction of the French metric system with complete subversion and abandonment of all our hereditary measures." Yet, strange to say, the old English mile is two kilometres, the furlong 200 metres, the chain 20 metres, and the fathom two metres, or building yard one metre, within the small uncertainty of our knowledge; and this system is based on a foot, which was not only known widely in the north back to Roman times, but was known to foreigners in Egypt for thousands of years earlier. It is curious that the metric system was thus closely anticipated, and it is exactly contrary to our author's statements.

Points at issue might be raised innumerably, but it would be useless to do so. The type of mind that is nourished by such material transcends the usual limits of facts and proofs, and remains for us as one of the interesting specimens in the museum of psychology.

W. M. F. P.

THE ANTHRACITE OF SOUTH WALES.

The Coals of South Wales, with Special Reference to the Origin and Distribution of Anthracite. By Aubrey Strahan and W. Pollard. Pp. vi+78. Memoirs of the Geological Survey of England and Wales. (London: H.M. Stationery Office, 1908.) Price 1s. 6d.

THIS memoir gives the results of an investigation into the character of the coals of South Wales. The collection of the material was begun in 1901, and the work has now so far progressed as to lead to an opinion as to the relative distribution of anthracitic and bituminous coals, and as to the origin of the difference between them. The results published include not only the analyses made for the purposes of the investigation by Mr. Pollard, Mr. E. G. Radley and Mr. C. A. Seyler, but also all previous trustworthy analyses of coal from recognisable seams. The total number of analyses is 203. In each case the particulars given include the local name of the seam, the colliery, the authority, the percentages of carbon, hydrogen, oxygen and nitrogen, the ratio of carbon to hydrogen, the percentages of volatile matter, and ash, the specific gravity, and the fuel ratio or the relation of fixed carbonaceous residue to volatile matter.

In view of the importance of considering the analyses of each seam separately, it was necessary to correlate, so far as possible, the seams of one part of the coalfield with those of another. The sequence of the seams has consequently received careful attention, and a plate of sections is given showing the position and correlation of the seams. The different bands of the same seam are compared, and the results are given of a comparison of different samples from the same seam in the same locality, as well as of different seams in the same locality. Other chapters deal with the analytical methods employed, with the accuracy of coal analyses and with the classification of coals.

Of the ten plates accompanying the memoir, five are iso-anthracitic charts designed to show areas of equal anthracitism in each seam or group of seams. The degree of anthracitism of each sample is expressed by the factor representing the relation of carbon to hydrogen. Among previous investigators there is a general agreement that the anthracitic character of the coals in part of the coalfield has resulted from a change effected upon coals which had been originally bituminous. Three explanations of the change have been put forward:—(1) that the anthracitic seams have been more deeply buried and consequently exposed to a higher temperature; (2) that they have been altered by adjacent plutonic rocks; and (3) that they are more affected by slip-cleavage. To these three theories there are serious

objections, and the investigations now recorded tend to show (1) that the seams are not all similarly anthracitic, and though each seam is generally more anthracitic than the one above it, there are many exceptions to the rule; (2) that the anthracitic character was not due to faults, but existed before the faults were formed; (3) that the anthracite existed as such before the coalfield was reduced by denudation to its present dimensions; and (4) that the percentage of ash diminishes *pari passu* with the decrease of bituminous matter. These conclusions point to the variations in the composition of the coals having been either original or at least of very early date. Indeed, of all the suggested causes of alteration subsequent to deposition, none appear to have been adequate to produce more than a slight modification of the differences due to original composition.

Written in faultless literary style and edited with scrupulous accuracy, this valuable addition to geological literature will appeal to a wide circle of readers, and the authors deserve great credit for the success they have achieved in the first attempt to define the distribution of anthracite and to explain its origin on purely experimental grounds.

VITALISM.

Versuch einer Begründung der Deszendenztheorie. By Prof. Karl Camillo Schneider. Pp. viii+132. (Jena: G. Fischer, 1908.) Price 3 marks.

A COUPLE of years ago Prof. K. C. Schneider published six admirably clear and objective lectures as an introduction to the study of the evolution-theory. It was a useful exposition of the facts of variation and heredity, and of the Darwinian and Lamarckian interpretations. The present volume is critical and personal, and is not easy reading. We cannot do more than indicate the author's point of view. The first half of the book deals with stimulus, psyche and consciousness, subject and individuation, sensation and heredity, need and purpose, and Darwinism. The second half deals with mutation, potency, and structure; orthogenesis and extinction; trophic stimulus; vitality; entelechy and heritability; phylogeny, and the becoming of man.

The author's general position is closely akin to the positivism of Mach and Avenarius, which is, he thinks, the stable foundation for that part of the biological edifice that now requires building. Biologically he is perhaps nearest Weismann, but he believes that the psychical is the most important biological factor; he will not hear of the transmission of somatic modifications, but he believes that the transmigration of souls is almost self-evident. In discussing Lamarckism he points out that it has two sides; on the one hand, it is an erroneous theory of passive transformation conditioned by external stimulus; on the other hand, it is a true theory of the subjective response of a creative agent. He develops this second idea which he calls by the extraordinary name of "Eulamarckism."

Prof. Schneider is a neo-vitalist who has the courage to say out and out that he believes in a specific vital energy, in a living substance. There are some who deny this, and maintain that life may be described as a succession of fermentations and the like, but this view ignores the phenomena of regulation and correlation, not to speak of memory and the power of profiting by experience. There are others who deny a living substance, and refer regulation and mental processes to an immaterial principle or agent, which deals directively with metabolism, though it is not of it. Schneider does not sympathise with either of these positions; he supposes a special vital substance, the vehicle of the specific vital energy, just as the ether is the medium for radiant energy. But this vital substance is not a particular kind of matter; it consists of psychical substances residing in the structural units of the organism. The relation between Psyche and Physis is illustrated by the mutual relations in thermochemical processes. The physical processes in the plasma, which are set going by stimuli, correspond to the chemical processes; the associated psychical energy corresponds to heat. On the one hand there is molecular movement, on the other there is cell-sensation. Life depends on the sensations of cells, as heat on the movements of molecules. As temperature is the intensity-factor of heat, structure is the intensity-factor of vitality, the measure of vital potency.

In a short notice it would not be for edification to try to expound the author's views on the four-dimensional character of consciousness or the law of the conservation of the psyche, or his theory that the mysterious process of assimilation represents a particular kind of gravitation, and that the psychical analogue of the force of cohesion is the entelechy or soul—the formative principle of the organism.

Prof. Schneider believes strongly in mutation, but the essential factor in species-formation is "*Descension*"—which means a thorough-going change in organisation, such as getting a notochord or gill-clefts. To study descensions is at present the most urgent task of ætiologists. What brings about a "Descension"? It is a step in the "entelechialen (synthetischen) Umprägung" which seems to be the most characteristic secret of the organism.

J. A. T.

OUR BOOK SHELF.

Arithmétique graphique. Les Espaces arithmétiques; leurs Transformations. By Gabriel Arnoux. Pp. xii+84. (Paris: Gauthier-Villars, 1908.) Price 3 francs.

THE title of this little work does not indicate, as the English reader might expect, another addition to the ever-growing list of treatises upon geometrical methods of calculation or the graphical solution of ordinary problems. It might rather be described as an essay upon the geometrical interpretation of the theory of numbers.

The author has attempted a systematic exposition of what may be called the geometry of abacs and magic squares. By an *arithmetical space* he understands the set of all points (in a geometrical space of any number of dimensions) the coordinates of which are integral, and he has worked out the properties of such point-systems. Many theorems true for con-

tinuous space hold unchanged for such a discontinuous space. Some operations, however, such as rotation and transformation of coordinates to new axes inclined to the original ones, are possible only in certain cases. The study of the conditions under which such operations are possible, and of the effect of these operations when the conditions are satisfied, forms the main drift of the book.

The most interesting chapters are those which deal with what the author calls *modular* spaces. A modular plane space of modulus m is a square of m^2 points, a point (a, b) of this square representing all points $(a+pm, b+qm)$ of the unlimited arithmetical space, p, q being arbitrary integers. Geometrical properties of the complete unlimited space yield corresponding properties of the fundamental modular square, the coordinates of the original points being replaced by their *congruent* numbers of modulus m.

Transformations of coordinates in such modular spaces lead to the construction of magic squares and abacs.

Graphical methods are given for the solution of diophantine equations, and the last chapter deals with a number of problems, among them the following, originally proposed by Euler; from each of six different regiments six officers of different rank are taken. The problem is to arrange them in a solid square so that in each row and in each column there shall not be two officers of the same rank or of the same regiment. This problem, which was shown to be insoluble by MM. G. and H. Tarry in the case of thirty-six officers, is soluble when there are sixteen, and the reasons for this are here discussed.

Strangely enough, this branch of mathematics, although it might well be classed amongst the purest of the pure, is not without its industrial applications, notably in the weaving of tissues and fabrics.

Altogether, we commend M. Arnoux's book to those interested in the mathematical curiosities of the theory of numbers.

L. N. G. FILON.

Contributions to the Study of the Early Development and Imbedding of the Human Ovum. By Dr. T. H. Bryce, Dr. J. H. Teacher, and J. M. M. Kerr. Pp. viii+93; 10 plates. (Glasgow: J. MacLehose and Sons, 1908.) Price 12*s*. 6*d*. net.

IT will be a glad day for the science of embryology when all the details of the sequence of the development of man are described from successive stages of the human ovum and embryo. The chick has, to a great measure, passed from the position that once it occupied, and even the lower mammals cannot be taken as substitutes for human material, when human development is to be rightly studied. Much that is confusing in embryology to-day is the outcome of reading whole pages of the embryonic life-histories of other creatures into the early chapters of human development.

In certain special directions the primates form a group distinguished developmentally from other mammals, and man and the anthropoids differ in some details from the other primates. Our knowledge of the development of man will, therefore, not be ideal until all our stages are accurately described from purely human material. Towards the attaining of this ideal, the description of the Teacher-Bryce ovum materially helps; at the same time, it probably holds out a guarantee for the further extension of our knowledge of the earliest stages of human development, for the material so carefully treated in this case is material that is often neglected.

The Teacher-Bryce ovum is the earliest human ovum yet described—its age is computed at thirteen to fourteen days—and, owing to the care taken in ascertaining the details of its history, this computation may be taken as final.

It is younger, by probably a day, than the well-known ovum of Hubert Peters, described in 1899, although that ovum was originally considered to be no more than three to four days old.

Great care and a wealth of detail have been used in making the account of this ovum as complete as possible, and in order to render the material of more value, a table of all the recorded early human ova has been incorporated for comparative purposes.

The volume in which this ovum is described also contains the description of an early ovarian pregnancy, and this—like the uterine ovum—is the earliest stage that has yet been described.

It is but natural that, in dealing with such material, many new details should come to light, and all the many points of novelty receive very ample discussion and illustration. The whole technic of the work, and especially the many fine illustrations, mark a distinct advance on the ordinary run of English scientific publications, and towards this perfection the authors have to thank the Carnegie Trust for assistance. Dr. Bryce has already demonstrated his specimens at the meetings of scientific societies, and the general features of his early ovum are now well known to embryologists, but the book in which he describes it contains, apart from the mere description, a vast amount of well-assorted detail, got together and presented in most workmanlike fashion.

Graphic Algebra. By Dr. Arthur Schultze. Pp. viii+93. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.) Price 4*s*. 6*d*.

IN this text-book the author first gives examples of plotting from physical and statistical data, and the graphing of simple functions of one and two variables. He then proceeds to the main purpose of the book, which is that of solving algebraical equations by the use of squared paper and a few standard curves. Equations up to the fourth degree are fully dealt with, and, in order to facilitate the work, a method is cleverly developed in which the direct graph is replaced by two loci of a simpler nature, the intersections of which give the required roots. Thus a quadratic equation is solved by reading off the intersection of a standard parabola and a straight line; the same parabola is used for all quadratics, and it is only the scale and the position of the line which vary. Instead of the parabola, a rectangular hyperbola may be used. Cubics are dealt with by means of the curve $y=x^3$ and a suitable straight line. Biquadratic equations are solved by the intersection of a circle and the standard parabola or standard hyperbola. In all cases it is shown how to find the imaginary or complex roots, if such exist.

The whole subject is treated in a very concise and interesting manner, and the reader should become fully conversant with the principles of graphing and the nature of algebraical equations. But the special methods, however ingenious, must be regarded rather in the nature of mathematical exercises than as having any very useful practical applications, for such equations occur so seldom outside text-books that when an actual case does arise, simple direct methods of solution are usually to be preferred. This admirable manual concludes with an appendix containing some "statistical data suitable for graphic representation," a short table of squares, cubes, square roots, and reciprocals of numbers, and a collection of answers to the many exercises which are provided throughout the text.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE.*]*

The Origin of Advent, and other Three Weeks' Celebrations.

FROM a series of measurements of solstitial monuments in Cornwall and Wales, Sir Norman Lockyer has advanced the theory that such monuments were erected, not so much to mark the exact solstice, as to give ample warning of that phenomenon. I have suggested from evidence in connection with fairs that the period of warning was three weeks, and Mr. W. E. Rolston finds measurements of three solstitial alignments, two at Tregaseal and one at Longstone, marking sunrise three weeks before the solstice.

When we come to think of it, marking the exact solstice sunrise must have been a difficult task. For three weeks or so, the sun's declination at the solstice is within one degree. Though the apparent stand-stillness of the sun at that point must have greatly impressed people from the earliest period, yet the Irish bard Amairgen could still boast :—

"Who teaches the spot where the sun rests (but I)?"

The astronomical three weeks' warning referred to seems to me to be the origin of our Christian Advent and Lent. What was intended as an astronomical warning of the solstice became, or most likely was from the first, a period of preparation for a great festival.

As to Advent, Daniel observes :—" The name Advent does not appear to have come into general use until long after the setting apart of the season which it designates, and the Greek Church to this day has no corresponding name for it " (" The Prayer-Book," p. 197). The season seems to be at first strictly limited to three Sundays, as the Bobbio Missal gives only three masses *in Adventu Domini* (Duchesne, " Christian Worship," p. 158). The commencement of the Advent season is associated with St. Andrew's Day, November 30, three weeks before the solstice.

The origin, use, and length of Lent have been similarly affected by Christian usage. Duchesne says that " at Rome it was the custom to observe the (Lenten) fast for only the last three weeks before Easter " (p. 243). " There were, however, Churches in which, up to the fifth century, Lent consisted of only three weeks of fasting " (p. 244). The inference is irresistible, that before Lent was made dependent on a movable Easter, it was a period of warning and preparation for a great solar festival.

But the question arises, Was the three weeks' interval measured from the exact date of the festival it led up to, or was it simply obtained by dividing the time between a May-year festival and a solstitial or an equinoctial one?

St. Andrew's Day, November 30, is mid-way between the astronomical Hallowe'en (November 8) and the winter solstice. At Llangefui, Anglesey, that whole period of six weeks, roughly, has been observed by six weekly fairs. The forty days of Lent is, of course, a similar arrangement for celebrating the whole period between a May-year festival and a solstitial one.

But it is to be noted, by the early observance of both Advent and Lent, that the last three weeks were of chief importance. At Magor, Mon., three weekly fairs used to be held immediately before Easter, a circumstance somewhat incompatible with the purpose of the Christian Lent, which, however, may be regarded as a curve in the evolution of Lent.

The calendar seems to be responsible for some displacement of the original three weeks' interval. Thus there are fairs held at Llanerchymedd, Anglesey, on the three first Wednesdays after November 13, or Old All Hallows.

To answer the question I have put, we must first consider the yearly course of the sun as divided into sixteen equal parts, or rough three-weeks' units, as follows :—

January 14.	May 6 M.	September 23 S.
February 4 M.	May 29.	October 16.
February 27.	June 22 S.	November 8 M.
March 21 S.	July 16.	November 30.
April 12.	August 8 M.	December 23 S.
	September 1.	

M = May-year, S = Solstitial-year.

Treating Lent as originally a warning of the vernal equinox, if not of the February festival, I begin with the May-day warning. I note four fairs held on April 15, exactly twenty-one days before the astronomical May-day, May 6, while the dividing point of the sun's course between the vernal equinox and May 6 is April 12, so the three weeks were counted as from May-day. The places are Ystradgynlais, Carmarthen, Penmark, and Penderyn. At three other places the fairs are held on April 16, namely, Aberdaw, Llangathen, and Devynnock.

That April 15 has reference to May 6 is fairly certain, because of the persistence, in spite of the calendar, of the astronomical May-day as a fair-day. At ten places in Wales fairs are held on May 6, namely, Abercennen, Laugharne, Castell Bychan, Mon., Castleton, Mon., Llanfynydd, Newcastle, Pemb., Llanfair Caereinion, Llangynog, Llanerchymedd, and Nantglyn. I have given the names of the places because of many facts connected with them which deserve further study in this connection. For instance, Ystradgynlais, Penderyn, and Devynnock occupy different slopes of the same mountain range, the Brecknock Beacons, where the May-year survives in its glory. Again, in all Wales it is probable that the traditions of May-day have not been better preserved than in the neighbourhood of Laugharne, where prehistoric monuments are numerous.

It may be said, then, that there was a three weeks' interval depending on May-day, and reckoned from that date.

Coming to the summer solstice, I note three fairs held on May 31, three weeks as reckoned from the solstice, instead of May 29. The places are Llangollen, Llanbrynmair, and Talgarth. The two-days' fair at Carmarthen, June 3, 4, leads up to June 24. The summer solstice is observed by fairs at Llandilo Fawr, Llantwit Major, Emlyn, Llanerchymedd, and Ely Bridge.

Depending on the August festival (August 8) are intervals of three weeks both before and after that date. At Llanerchymedd, fairs are held on the three Wednesdays before August 7. That takes us back to July 17. The true commencement of the preparatory interval would be July 18, and not 16, as per table given. There are fairs at Haverfordwest and Llanidloes on July 18, and one on July 19 at Caerphilly. It is interesting to note that a ten-days' fair at Warrington, Lancs, commenced on July 18. At two contiguous places, occupying different slopes of the same mountain range, the three weeks' interval is reckoned after the August festival. There are fairs held at Rhayader, Radnorshire, on August 6 and 27, and at Rhos, Cardiganshire, on August 5 and 26.

I find only one warning interval of the autumnal equinox, but it is as decisive as any. At a noted mountain fair-place, called Waen, where the boundaries of Breconshire, Monmouthshire, and Glamorganshire meet, fairs are held on September 2 and 24.

That there was a three weeks' interval depending on All Hallows is shown in the case of Llanerchymedd, where fairs are held on the three first Wednesdays after November 13, Old All Hallows. The commencement of a preparatory three weeks' interval, leading up to November 8, would be October 18, and fairs are held on that date at Haverfordwest and Myddfai. The latter place is famous for its wealth of tradition. At Llanfechell, Anglesey, fairs are held on November 5 and 25, which should be compared with the Llanerchymedd fairs in the same county.

Fairs are held on November 30, St. Andrew's Day, in Cardiff and at Llansannan, and that was the date of the commencement of a ten-days' fair at Warrington.

It is in Anglesey, where Sir Norman Lockyer observed a tendency in the monuments to ante-date the solstice, so to speak, that we find definite arrangements of fairs confirming his findings.

Information on the point, from the monuments and the fairs or festivals, is as yet incomplete. I am only trying to coordinate some of it. A court used to be held every three weeks in the parish of Llangeinor, Glam. The Roman notice of the Comitia extended over three market-days. Banns must be published on three Sundays.

Concerning the winter solstice celebrations, one is reminded of the Boy Bishop of Salisbury, a choir-boy elected as bishop on St. Nicholas' Day, December 6, who was allowed to bear the title until Holy Innocents' Day, December 28, just three weeks. The Christmas festivities used to be continued in Pembrokeshire for three weeks. The Government in the time of Charles I. prohibited the playing of cards, &c., at Gray's Inn during the year, "except on the twenty days of Christmas holidays only."

I cannot help thinking that a three weeks' interval is provided for in the orientation of some churches. As a rule, the older churches are oriented to May or November; then come churches oriented to the equinox. I find N. 76° or 77° E. and N. 80° or 81° E. to be rather common orientations.

Since writing the foregoing, I have looked up some Welsh calendar lore. Provision seems to have been made for the various three-weeks' intervals suggested by the fairs. There appear to have been four Lents, as they may be called. The source of my information is Dr. Gwenogvryn Evans's report on a Peniarth MS., which he dates "after 1484" ("Report on Welsh MSS.," vol. i., pp. 406–7). Dr. Evans gives only the beginning of each item in the MS.

There was a "pask bychan," little Easter, connected with the Feast of St. Hilary, January 13, which is just three weeks before the February festival of the May-year, February 4. January 13 is also St. Elian's Day, and at Llanelian, Anglesey, the Gwyl Mabsant, or patronal wake, used to be prolonged for three weeks.

Then there was the "pask" (Easter) proper. Mention is also made of the "pask kynharaf," the earliest Easter, though the report on the point is tantalisingly brief. As Easter proper ends the ecclesiastical year, the "earliest Easter" may very well be connected with the August festival of the May-year, August 8, as suggested by the fairs.

Then comes the "grawys ayaf," winter quadragesima. It is connected somehow with the Feast of St. Linus, and that is all I can gather from the report. St. Linus' Day is November 26. Though the word "grawys" is a shortening of "quadragesima," perhaps it is here applied to the shorter interval of Advent. It certainly corresponds with the latter. It is worth noting, however, that January 13 is some forty days from the beginning of the winter "grawys."

Thus we have three "pasks" or Easters mentioned, and the word "grawys" used twice. I suspect that there were four of each, corresponding with the four seasons of the year, and the four Gorsedds of the Bards.

John Griffith.

Women and the Chemical Society.

We venture to ask for the hospitality of your columns in order to make a statement of some importance in view of the announcement made by the president of the Chemical Society of the large majority of the fellows who are in favour of the admission of women to the society (Proc. Chem. Soc., 1908).

Four years ago a memorial was presented to the council of the Chemical Society praying for the admission of women to the fellowship of the society. This memorial bore the signatures of nineteen women, all of whom were lecturers or demonstrators in chemistry in university colleges or actively engaged in original chemical investigations. The council at that time was unable to take any steps in the matter, but promised that the memorial should not be lost sight of in any further action that might be taken (Proc. Chem. Soc., 1905, xxi., 103).

The question having been raised again by the presentation of a petition signed by 312 fellows in June last, we communicated in July with our co-signatories of the 1904 memorial, and with other women of equal repute as chemists, in order to ascertain how many women at the present time desire the privileges afforded by fellowship of the Chemical Society.

We have received replies from twenty-eight women, all of whom are of similar standing and possess similar qualifications to those of the original signatories, expressing their interest in the present movement and their intention of at once becoming candidates for admission to the fellowship of the Chemical Society if the council should reach a favourable decision in this matter.

From rumours that have reached us, there appears to be some uncertainty in the minds of some fellows of the society as to the number of women who are prepared to avail themselves of the first opportunity of seeking the fellowship, and we hope that the publication of the above statement will remove all misunderstanding on this point.

Ida Smedley.
M. A. Whiteley.

November 9.

Mercury Bubbles.

I remember seeing mercury bubbles, like those described by Mr. J. G. Ernest Wright in Nature of November 5 (p. 8), sixty years ago, when I was a junior student at the Royal College of Chemistry under Hofmann. In the basement laboratory was a tap delivering water under considerable pressure from a cistern on the roof, and it was a favourite experiment to take a basin half full of mercury and water and to turn the tap suddenly on it. The rush of water carried down air into the mercury, and great bubbles of the metal rose, floating on the surface of the water. I do not remember seeing bubbles as large as 22 mm. in diameter, but frequently they were as large as ordinary marbles.

I cannot recall any publication of the phenomenon, but there must be many chemists living who can corroborate what I have described. William Crookes.

November Meteors.

That memorable and suggestive epoch, the middle of November, has again arrived. At midnight the well-known stars in the "Sickle of Leo" exhibit themselves in the east and suggest meteors galore to the expectant observer. The conditions are not favourable this year, for the parent comet returned in 1899, and must now, with the denser region of its meteoric swarm, be at an immense distance from the earth. The probability is, therefore, that we shall only encounter a tenuous part of the stream, and that a few straggling Leonids will illumine our skies on the nights following November 14 and 15, but the meteors may be much more numerous than expected, as they have been in certain previous years.

The moon will be near her east quarter, and situated in the same region of sky as the radiant at the important time, so that her light will offer some impediment in regard to the fainter meteors.

It will be desirable to maintain a watch of the sky on the mornings of November 15 and 16, and to record, not only the number of meteors visible, but the apparent paths of the brighter ones. An important end is served by securing duplicate observations of individual objects, and thus enabling their real paths in the atmosphere to be computed. Apart from this the annual observation of a meteoric shower, whether rich or feeble, is necessary in learning its history, for even negative results concerning its return may be really valuable, though the spectacular effects are disappointing in the extreme. With particular regard to the Leonids they are never wholly absent, being

distributed along the complete ellipse forming the cometary orbit. They are therefore always worth careful notice, and will seldom be found to fall below reasonable expectation.

Bristol, November 4. W. F. DENNING.

THE result of calculations made by the writer indicates that the Leonid epoch will fall a little later this year than might have been expected. There will be little, if any, meteoric activity during the period November 10–16, reckoning from noon to noon, but during the remainder of the month it is likely that shooting stars will be much in evidence. The following are the principal meteor showers that fall during the period November 16–30, the dates of the occurrences being expressed in Greenwich astronomical time:—

Epoch November 16; this shower is of the ninth order of magnitude, and has the following maxima:—November 16, 11h. 20m.; November 17, 4h. 25m., 8h. 20m., and 16h. 15m.

Epoch November 17, 20h., of eleventh order of magnitude. The following maxima occur after the epoch:—November 18, 0h. 50m., 10h. 14m.; November 19, 0h. 40m., 5h. 5m., and 16h. 50m.

Epoch November 20, 5h., of fifth order of magnitude, and preceded by the following maxima:—November 18, 7h. 50m., 21h. 5m.; November 19, 5h. 55m.; November 20, 3h. 15m.

Epoch November 24, of seventh order of magnitude, which has the following maxima:—November 24, 8h. 55m., 12h. 10m.; November 25, 6h. 20m., 18h. 24m.

Epoch November 30, 5h., of fifteenth order of magnitude, and preceded by the maxima:—November 28, 14h. 30m., 20h. 30m.; November 29, 0h. and 3h., 20h. 45m.

It seems from the foregoing that the first maximum takes place on November 16 during the hour preceding midnight. This maximum, which is the only one occurring on this night, will probably furnish some Leonids, which may also be observed on the following night.

131 Rathgar Road, Dublin. JOHN R. HENRY.

The Keeping of Young Herring Alive in Captivity.

ON p. 305 of the new number of the Journal of the Marine Biological Association reference is made to the difficulty of keeping young herring alive. On September 14 last I captured a number of young herring; some, which I put under circulation in salt water, were dead next morning. To kill the others I turned on a fresh-water tap into the bucket containing them. Half an hour or so later I found that, instead of being dead, they were very lively, and some which had been lying on their backs had recovered.

I then placed seven under a circulation of half salt water and half fresh water. They lived for a week, then some of them died off. There is still (November 6) one lively specimen living, and apparently healthy. The only source of food is a little plankton added (twice), and such plankton as comes through the salt-water pipes.

During the first few days of this experiment sometimes the salt-water tap and at other times the fresh-water tap was shut off for an hour or so.

RICHARD ELMHIRST.

Marine Biological Station, Millport, N.B.

Lime Light.

I VENTURE to direct your attention to a simple device which I have found very useful for increasing the light from a demonstrating lantern. It is usual, on account of their long life, to use so-called artificial lime cylinders, even though they give somewhat less light than pure lime ones. An ordinary Welsbach gas-mantle happens to fit all these cylinders, and should be slipped on before the jet is lighted. The increase in brightness of the light due to this addition is astonishing. The mantle is only slightly damaged by the jet, and by turning occasionally so that the flame impinges upon a fresh place, the intense illumination may be maintained for two hours or so.

Shooters Hill, Kent. CHARLES E. S. PHILLIPS.

ALBRECHT VON HALLER.

ALBRECHT VON HALLER, anatomist, physiologist, botanist, and poet, was born in Berne on October 16, 1708. He has been termed "Berne's greatest son," and his intellectual eminence was conspicuous even in an age which was singularly productive of great men. It was, indeed, early manifest, for the child Haller was what the Germans term a "Wunderkind"—one of the few such children whose subsequent career has borne out the promise of their youth. As early as his ninth year he began the preparation of lexicons of all the Hebrew and Greek words in the Old and New Testaments, with notes regarding their derivations and different applications. He also prepared a Chaldaic grammar. Whilst still a boy he wrote biographies of no fewer than two thousand celebrities and turned out innumerable verses (which he afterwards burned) on all conceivable subjects, including a satire in Latin verse on his somewhat harsh and pedantic preceptor. Before he was fifteen he was deeply immersed in philosophy and mathematics, and already showed that inclination towards the natural sciences which eventually evidenced itself in the remarkable works which appeared from his pen.

At fifteen he entered the University of Tübingen and pursued the study of anatomy and philosophy during two years. At this time Boenhaave, a man of similar almost universal genius, then at the zenith of his fame, was attracting to Leyden earnest students from all parts of the civilised world. The youthful Haller was also drawn into the vortex, and came under the influence both of that great physician and of the anatomists Ruysch and Albinus. After graduating there at the age of nineteen, Haller visited England, and in London made the acquaintance, amongst others, of Sir Hans Sloane, Douglas, Cheselden, and John Hunter. He then proceeded to Paris, where he spent six months studying anatomy and botany under Winslow and Jussieu. After leaving Paris, he passed a year in Bâle, pursuing mathematical studies under Bernouilli, and preparing himself for the active practice of medicine in his native city, where he intended to settle down. At the age of twenty-two we accordingly find him in practice in Berne. His patients do not appear to have been numerous; indeed, it was currently reported that he was "too good a writer and poet to understand much of medicine," and he found abundance of time for working at anatomy and for expeditions to the neighbouring Alps, the flora of which especially excited his interest. The poem entitled "Die Alpen," which was composed by Haller about this time, is probably the one by which he is best known; the following two verses from it, set to music as a cantata by Dr. Munzinger, were sung at the unveiling of the Haller statue on October 16:—

> Wohl dir, vergnügtes Volk! o danke dem Geschicke,
> Das dir der Laster Quell, den Ueberfluss, versagt;
> Dem, den sein Stand vergnügt, dient Armut selbst zum Glücke,
> Da Pracht und Ueppigkeit der Länder Stütze nagt.
>
> Zwar die Natur bedeckt dein hartes Land mit Steinen,
> Allein dein Pflug geht durch, und deine Saat errint;
> Sie warf die Alpen auf, dich von der Welt zu zäunen,
> Weil sich die Menschen selbst die grössten Plagen sind.

In 1735 Haller had begun to lecture in public on anatomy, and was physician to the city hospital in Berne. We also find him fulfilling the function of keeper of the public library and collection of coins. In the short year occupied with these multifarious duties he found time to prepare a "catalogue raisonné" of all the books in the library, and to differentiate and arrange in their chronological order 5000 ancient coins. In the following year George II.

of England, who was establishing a university at Göttingen, induced Haller to accept the chair of medicine, surgery, anatomy, and botany. He there gave himself up entirely to professorial duties and to work in natural science. He was instrumental in founding, in 1737, the Royal Society of Sciences in Göttingen, of which he became secretary and president, and the first meetings of which were held in his house. After seventeen years in Göttingen he accepted the invitation of his fellow-citizens to return to Berne, where already, in his absence, he had been elected a member of the Supreme Council, and he now (1753) devoted himself to administrative duties with the same energy that he had put into literary and scientific studies. These studies were not, however, arrested, for every moment of his time unoccupied by public affairs continued to be filled in by them, and his activity in this respect ended only with his death in 1777. He even sent a detailed account of his last illness to the Royal Society of Göttingen, and is said to have remarked to his physician at the approach of death that his pulse was no longer perceptible:—"Es schlägt nicht mehr!"

Haller is justly celebrated as a botanist, and had he not been a contemporary of Linnæus, whose great reputation eclipsed that of all his fellow-workers, he might have attained as high a position in that science as he reached in anatomy and physiology. He prepared a complete flora of Switzerland, and propounded a system of classification—artificial, it is true (as was that of Linnæus), but one which might have served a useful purpose in the absence of the Linnæan system. He published several important botanical works, the chief being the "Historia stirpium indigenarum Helvetiæ," which appeared in 1768 in three folio volumes with one volume of plates; the "Bibliotheca botanica," 1771–2, in two quarto volumes; the "Histoire des Plantes vénéneuses de la Suisse," 1776, and several descriptive monographs.

As an anatomist Haller was still more eminent. Already in 1733 he published at Berne a "Dissertatio anatomica de musculis diaphragmatis," followed in 1738, at Göttingen, by another, "De Valvula Eustachii." In 1743 he began the publication of his great work, the "Icones anatomicæ," which appeared in eight successive folio parts, the last in 1756. This was the first anatomical work in which the organs of the body are shown as much as possible in relation to one another, a principle which has been followed by all subsequent authors. As accessory to his anatomical writings may be mentioned his contributions to development and pathology.

But it is as a physiologist that Haller unquestionably ranks highest—indeed, modern physiology may be said to date from the appearance of his great work, "Elementa physiologiæ corporis humani," which came out from 1757–1766 in eight quarto volumes.[1] Into this book he collected all the physiological knowledge of his time, and the clearness with which he narrates the facts of physiology and the logical manner in which he draws deductions from them may serve as a model for modern text-books. His manner of pursuing a theme and clinching his conclusions is shown even by the mere titles of his chapters. Thus, in the section of the book in which he deals with the history of the discovery of the circulation and the attempts which had been made to detract from the claims of Harvey to the merit of the discovery, these titles read in succession as follows:—

XXIV. "Harveio laus circuitus inventi vindicatur." XXV. "Non exstat apud Hippocratem." XXVI. "Neque apud Salomonem, Platonem, veteres alios." XXVII. "Neque apud Servetum, Jacobum Reeff (longe minus)." XXVIII. "Quid Cæsalpinus viderit (non penitus tamen verum vidit, Harveio reservatum)." XXIX. "Non est inventum Pauli Sarpi." XXX. "Neque aliorum nuperorum." XXXI. "Neque Sinensium aut Persarum." XXXII. "Sed Harvei." For every statement the authority is given. Wherever possible, an observation is confirmed by himself. The descriptions of physiological phenomena are concise and clear. The deductions are not always those which we are now in the habit of drawing, but the exceptions are singularly rare.

It was only the dawning of chemistry, and many branches of physics were unknown; physiology,

Albrecht von Haller.

therefore, in those days had to be based mainly upon the study of anatomy. "Physiologiæ est animata anatome," says Haller in his "Primæ lineæ physiologiæ in usum prælectionum academicorum," a little handbook for medical students, published at Göttingen in 1748, which went through eleven editions. In the same work (p. 41) he recognises the value of animal experiments in advancing the knowledge of human physiology:—"Accuratiora sunt quæ in vivis animalibus facta sunt experimenta," and he is even more emphatic on this point in the introduction to his "Elementa."

When it is stated that Haller published nearly 200 works, it must be admitted that few or none have possessed a more fertile literary ability, especially when the scope of many of these works is taken into consideration. For, besides the great tomes on botany, physiology, and anatomy already mentioned,

[1] "The year 1757 may be regarded . . . as indicating the dividing line between modern physiology and all that went before. It was the year in which the 'Elementa Physiologiæ' of Haller was published." Michael Foster, "History of Physiology," p. 204.

he prepared and published no fewer than four large biographical works, one on botany, one on anatomy, one on surgery, one on practical medicine—the first of these in two quarto volumes, and the last occupying as many as four. These "Bibliothecæ" contain not only lists of scientific works, but also short analyses and criticisms of their contents, along with biographical notices of the authors—a titanic labour of vast utility to subsequent workers. Nor were his writings confined to the natural sciences. As we have already seen, he early attained considerable fame as a poet; later we find him publishing historical novels —"Usong, an Oriental Story," 1771; "Alfred, King of the Anglo-Saxons," 1773; "Fabricius and Cato, a Fragment of Roman History," 1771. His "Journal," which was published ten years after his death, contains his opinions on other literary men and on things in general, and especially philosophy and religion. Both this and his correspondence manifest strong conservative and anti-democratic views, with a tendency to intolerance towards those who held different opinions.

Haller was loaded with honours during his lifetime. He was an honorary member of almost all the learned societies of Europe. Frederick the Great in vain attempted to induce him to settle in Berlin, and the endeavours of Oxford and Utrecht to obtain his services were equally futile. The King of England appointed him his physician, and the Emperor of Germany granted him a title of nobility. But he was himself content to live and die a simple citizen of Berne, a prophet not without honour in his own country.

Haller's bicentenary was celebrated at Berne with great ceremony in October by the inauguration of a statue erected in front of the university on a height overlooking the town. On the day preceding the inauguration a joint session of the Historical, Medico-chirurgical, and Scientific Societies of Berne was held in the hall of the university, which was occupied by a large audience, including many ladies. Interesting accounts of Haller's life and work were given by Prof. Steck (history), Prof. Fischer (botany), and Prof. Kronecker (physiology). Addresses were also received from various societies with which Haller had been connected, as well as from universities and other learned bodies. The societies were represented by Prof. Leo, who appeared for the Royal Society of Sciences in Göttingen; Prof. Waldeyer, for that of Berlin; Prof. Heger, Brussels; Prof. Bohr, Copenhagen; Prof. Rückert, Munich: Prof. Wangerin, Halle; Prof. Gamgee, London (presenting a Latin address from the Royal Society); Prof. Schäfer, Edinburgh: whilst the universities were represented by Prof. von Grützner, of Tübingen: Prof. Merkel, of Göttingen; Prof. Kollmann, of Bâle; Prof. Ewald, of Strassburg, and others. In the evening a reception was held in honour of the foreign delegates by the president of the memorial committee, Prof. Tschirch.

The actual day of the inauguration (October 16) was kept as a public holiday. A procession of all those who were to take part in the ceremonial, including the Swiss and foreign delegates, the university authorities, and the students—the latter with the banners and in the uniforms of their respective corps —was marshalled in front of the Parliament buildings, and marched through the principal streets of the old city to the site of the memorial. There, orations were pronounced by the rector of the university, Prof. Tschirch, and by State Councillor Dr. Gobat, representing the Education Department of the Canton. A fine choir of men's voices rendered a selection of appropriate music, and in glorious sunshine, to the accompaniment of the booming of cannon and the sound of the Swiss national anthem, the covering which had concealed the monument was removed, and the representation of Haller, by Siegwart, of Lucerne, was displayed to the view of the assembled multitude.

The statue represents Haller as he might have appeared to his contemporaries in about his fiftieth year. No contemporary picture or bust of this period of his life is extant, although his appearance in earlier and in later life is not unfamiliar. The sculptor had, therefore, to imagine him at the period chosen—which was that of his greatest scientific activity—a circumstance which has certainly not detracted from the artistic merit of the statue.

The unveiling ceremony was followed by a banquet to the delegates and others who had been invited to the celebration. Not the least interesting of the guests were some of the direct descendants of Haller. Indeed, the reply of M. Albert de Haller, of Lausanne, to the toast of the Haller family showed that some at least of the literary ability of his ancestor has descended to his generation.

The festivities were wound up by a torchlight procession of students, followed by a "Kommers" in the Kornhaus-keller.

A bronze plaque, exhibiting the bust of Haller in profile, designed by the sculptor of the memorial, was struck to commemorate the bicentenary, and a copy was presented to each of the foreign delegates—an artistic memento of a memorable ceremony.

E. A. S.

CAISSON DISEASE.[1]

MEN who have been working in compressed air, either under water in diving dresses or diving bells, in caissons used in preparing foundations for bridges, &c., or in making shafts or tunnels through watery ground, are liable to a variety of symptoms known generally as "caisson disease." These symptoms, which come on only at or shortly after the return to atmospheric pressure, vary in severity from pains in the muscles and joints, known as "bends" or "screws," to paralysis and even death. Paul Bert showed experimentally thirty years ago that these attacks are due to the fact that air (chiefly nitrogen) which has been dissolved in the fluids and tissues of the body while under pressure may, on decompression, be liberated in the form of bubbles, which produce local or general blocking of the circulation or other injuries. He also showed that if decompression were effected sufficiently slowly, the excess of air which had been taken up could escape by diffusion through the lungs, and thus bubbling and symptoms could be avoided. The phenomenon is, in fact, that of decompressing soda-water by pushing in the stopper; the problem of the prevention of caisson disease is how to push it in so slowly that the gas can escape without forming bubbles, and without the loss of so much time that the primary object of the manœuvre is frustrated.

Practical experience has shown clearly that the incidence of caisson disease varies with the height of the pressure and the duration of exposure to that pressure. Cases of illness are much more frequent in caissons where the pressure required to keep out the water approximates to 45 lb., or 3 atmospheres in excess of atmospheric pressure, than in those which are worked at about 20 lb. or 25 lb. Yet far higher pressures may be experienced with impunity

[1] "The Prevention of Compressed-air Illness." By A. E. Boycott, G. C. C. Damant, and J. S. Haldane (*Journal of Hygiene*, vol. viii., 1908, p. 342).

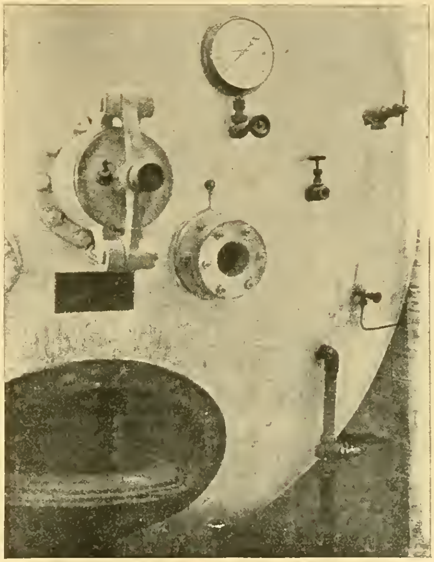
if appropriate precautions be taken. Dr. Greenwood has exposed himself to as high a pressure as 92 lb. in an experimental pressure chamber, and Lieut. Damant and Gunner Catto have descended in diving dresses to a depth of 210 ft., or 94 lb. In these cases the time of exposure to compressed air was very short, and human experience in caisson work definitely shows that it is more dangerous to work for six hours than three, and that exposures of half an hour or so are usually quite free from risk. Practical experience is, however, by no means so clear with regard to the salutary effect of prolonging the period of decompression. The cause of this is that the really slow decompressions which are necessary have hardly ever been tried in actual practice, with the result that many practical men are still somewhat sceptical as to the truth of Paul Bert's discovery.

The formation of gas bubbles in the living body obviously depends on the pressure of the gas dissolved in the body being greater than the external pressure. It is, however, well known that liquids, and especially sticky liquids such as blood, can hold gas in a state of supersaturation at pressures much in excess of the external pressure without the formation of bubbles, especially if they are not agitated or brought into contact with foreign substances. These phenomena are well illustrated by soda-water after decompression, noting the effects of shaking the bottle or adding sugar to the lemon-squash. If the limit of "safe" supersaturation is exceeded, bubbles are formed. Whether this occurs or not in the body will depend, then, on the extent to which the body has become saturated while under pressure, and the point to which the saturation has been reduced during decompression. How much gas is taken up while under pressure and given off during decompression depends in the main on the height of the pressure, the duration of exposure, the duration of decompression, and the activity of the circulation of the blood, which is the means whereby the air is brought from the lungs to the tissues, and subsequently evacuated from the tissues *viâ* the lungs.

The different parts of the body vary very widely in respect of the quantity of blood passing through them in unit time. Those that are freely supplied with blood, such as the kidneys, take up excess gas very quickly, and in such parts the nitrogen pressure soon comes into approximate equilibrium with the nitrogen pressure in the air in the lungs. By some ingenious experiments Drs. Hill and Greenwood have shown that this point is reached in as little as ten minutes in the case of the active human kidney. Practical experience shows, however, that other parts of the body take much longer—four or five hours or more—to become saturated with nitrogen at the given excess air pressure, and, further, that the importance of these slowly saturating parts as regards caisson disease is much greater than that of organs which saturate quickly, and which, therefore, desaturate correspondingly fast on returning to atmospheric pressure.

The duration of the exposure to high pressure is, then, of the utmost importance; it should in all cases be reduced to the shortest practicable time. The duration of decompression must, on the other hand, be much extended if accidents are to be avoided. It is also clear that the rate of decompression should be adjusted to the height of the pressure and the duration of exposure; what is safe after one hour at 60 lb. pressure would be waste of time if the pressure had been 30 lb. or the time of exposure only ten minutes.

Human experience shows that symptoms practically never occur after decompression from a pressure of 15 lb. in excess of atmospheric pressure, however long the exposure or however short the period of decompression. In other words, it is safe to reduce the pressure quickly from 30 lb. absolute to 15 lb. absolute. Experiments made at the Lister Institute with the aid of the pressure-chamber presented by Dr. Ludwig Mond showed that the principle that the ***absolute*** pressure may always be safely halved held good up to at least 6 atmospheres. A goat, for example, may be quickly decompressed from 75 lb. (90 lb. absolute) to 30 lb. (45 lb. absolute) without ill effects, while a similar rapid drop of 45 lb. from 60 lb. absolute to 15 lb. absolute is frequently followed by severe symptoms. Under a pressure difference of 45 lb., nitrogen rapidly leaves the tissues, is carried away by the blood, and diffuses through the lungs without forming bubbles. After a time,



The steel chamber at the Lister Institute. Front end, showing the manhole for entering, the small air-lock for passing food, &c., into the chamber, an inspection window, a pressure gauge, and several valves, &c (From the *Journal of Hygiene*.)

which may be approximately ascertained by calculation, the pressure in the body will have fallen from 75 lb. to, *e.g.*, 61 lb.; the absolute pressure may again be halved, making the air pressure 23 lb. The difference of pressure inside and outside the body is now only 38 lb., so that nitrogen leaves the body more slowly than before. Ultimately the pressure difference, which must never be much more than the absolute air pressure, becomes so small that the excess gas escapes very slowly. Consequently, the rate of decompression must be made slower and slower as the pressure falls, the final decompression from 15 lb. to atmospheric pressure occupying perhaps as much as 60 minutes.

It has hitherto been customary to recommend that decompression should be effected at a uniform rate throughout, such as 20 minutes for each atmosphere of excess pressure. Such a procedure is altogether unsound; the rate suggested is needlessly slow for

the early part of decompression, and much too fast towards the end. To decompress safely a man after a long exposure at, *e.g.*, 75 lb. pressure would probably require eight or ten hours if the pressure were reduced at a uniform rate throughout; by the new method here described not much more than three or four hours would be required. At such pressures it is clear that in practice the time of exposure must be reduced.

THE DIET OF THE HINDU.[1]

CHITTENDEN'S well-known work on diet advocates a reduction of the nitrogen intake to an amount far below that in the standard Voit dietary. By experiments on others and himself, he endeavoured to show that a low protein diet is compatible with bodily equilibrium and health. He directs attention to the well-known fact that the muscular energy of the body makes little or no call on the nitrogenous constituents of the muscles, and urges that the excretory channels, such as the kidneys, are overworked and so liable to damage when dealing with the large amount of waste nitrogen which it is the habit of the white races to ingest.

The conditions which Chittenden artificially constructed for the subjects of his experiments are found ready made on a large scale in the teeming millions of Bengal. It is quite obvious that much more correct conclusions as to the ultimate outcome of a reduction of the protein intake to less than half the European standard can be drawn from such a huge experiment, extending over the lives of a population, than it is possible to deduce from a limited series of observations on a few men lasting only for a few months. Scientific investigators therefore owe a debt of gratitude to Prof. McCay for the brilliant piece of work in which he has systematically and statistically grappled with the problem.

He admits it is perfectly true that the Bengali of varying castes maintains nitrogenous equilibrium on his poor vegetarian diet, and he naturally does not dispute the dictum that nitrogen is not the source of muscular energy. But his conclusion is that the low nitrogen intake acts deleteriously; the amount of protein in the blood is permanently decreased in amount, and the poor pabulum provided for the muscles leads to work in disadvantageous circumstances, and tends to produce degenerative changes in the body cells, notably in the kidneys. Not only is the output of work by the Hindu miserably small in comparison with the European labourer, but he is more easily fatigued, his blood-pressure is below the normal, and his lack of reserve force renders him an easy prey to bacterial infection and other forms of disease. His body weight and measurements show the native to be a puny person, exhibiting all those signs usually associated with an under-fed condition.

[1] Scientific Memoirs by the Officers of the Medical and Sanitary Departments of the Government of India (No. 34). Standards of the Constituents of the Urine and Blood and the bearing of the Metabolism of Bengalis on the Problems of Nutrition. By Capt. D. McCay. Pp. iv+67. (Calcutta: Superintendent Government Printing, India, 1908.) Price 2s. 2d.

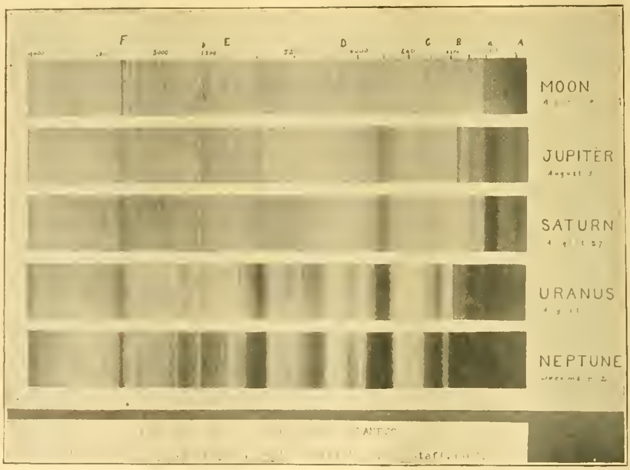
Even if one grants that in the normal decomposition of proteins, toxic substances are formed which may act injuriously upon the body, it must be remembered that in health the body is provided with an efficient machinery for eliminating them. It is by no means certain that decomposition products, also toxic in nature, are not formed from the fat and carbohydrate of the diet. The large carbohydrate intake rendered necessary by a diet poor in nitrogen seems to be full of danger, and the extreme prevalence of diabetes in its most aggravated forms among the Bengalis proves conclusively that the evils due to excess of carbohydrate are even more real than those supposed to be due to excess of protein.

The favourite argument of the vegetarian is to point to the races of the east as examples of the good results accomplished on a low diet. Such an argument has been refuted more than once, and its fallacies have been finally demonstrated by Prof. McCay's observations and statistics.

W. D. H.

THE SPECTRA OF THE MAJOR PLANETS.

AS the result of his experiments, Mr. V. M. Slipher succeeded in 1907 in rendering some plates (Seed, 23) sensitive far into the red. This was done by bathing them before exposure in a solution of pinacyanol, pinaverdol, dicyanin, alcohol, and water. With them he photographed the spectra of all the major planets and, for comparison purposes, that of our moon.



The results are shown in the accompanying print, made by enlarging, combining, and re-photographing on one plate all the spectra. Three things are to be observed in the spectra :—

(1) The great number of new lines and bands disclosed. Some of these are evident in the spectra of Jupiter and Saturn, but chiefly in those of Uranus and Neptune.

(2) A steady progression in the intensities of the non-solar lines and bands as one goes outward from the sun.

(3) The intensification of the hydrogen lines F and C, notably in Uranus and Neptune.

PERCIVAL LOWELL.

NOTES.

THE list of honours conferred upon the occasion of the King's birthday includes the names of three Fellows of the Royal Society. The Order of Merit has been conferred upon Dr. A. Russel Wallace, F.R.S.; Prof. J. J. Thomson, F.R.S., has been knighted; and Dr. J. Hutchinson, F.R.S., has received a like honour. Other recipients whose names are known in the scientific world are Principal Macalister, Glasgow University, who has been appointed a Knight Commander of the Order of the Bath (K.C.B.); Sir G. Anderson Critchett, who has been made a baronet; Dr. T. Oliver and Dr. N. Bodington, Vice-Chancellor of the University of Leeds, both of whom have received the honour of knighthood.

WITH deep regret we have to announce that Prof. W. E. Ayrton, F.R.S., died on Sunday morning at sixty-one years of age.

IT was announced at the West Ham Town Council on Monday that the freedom of West Ham had been privately conferred upon Lord Lister at his house in the country, as he was prevented by a weak state of health from receiving the distinction in public. Lord Lister was born at Upton, Essex, in the borough of West Ham.

WE are asked to announce that on November 28, at 2 p.m. promptly, Mr. Abbott H. Thayer, the discoverer of the concealing effect of the counter shading of the costumes of animals, will give at the Zoological Gardens, Regent's Park, a further demonstration of the obliterative effect of the patterns of so-called "conspicuous" species, illustrated with actual bird-skins, butterflies, &c., as well as with artificial apparatus and drawings. Visitors are requested to assemble in front of the superintendent's office.

MM. EDMOND PERRIER and Van Tieghem are to represent the Paris Academy of Sciences at the Darwin centenary in Cambridge next June.

THE death is announced, at the age of sixty-five, of Prof. Alfred Ditte, professor of chemistry in the University of Paris, and member of the Paris Academy of Sciences.

A REUTER telegram from Ottawa announces the death of Dr. James Fletcher, Dominion entomologist, and honorary secretary of the Royal Society of Canada.

SIR DANIEL MORRIS, K.C.M.G., has been elected an honorary life Fellow of the Royal Horticultural Society in recognition, among other matters, of his services to our Colonial Empire, and especially to the West Indies.

THE death is announced of Dr. Cecil G. Dolmage, a Fellow of the Royal Astronomical Society and many other learned societies at home and abroad, and author of "Astronomy of To-day" and other works.

MR. W. K. DAVEY has given the sum of 1000*l.* towards the initial expenses of the Australian Institute of Tropical Diseases shortly to be established at Townsville, North Queensland.

THE American Association will hold a special Darwin celebration meeting on January 1, 1909, when a number of papers upon subjects bearing upon evolution will be presented by leading naturalists. It is intended to issue the papers in a memorial volume.

WE notice with regret the announcement of the death of Mr. Archibald J. Little, who did much geographical work in the interior of Asia. Mr. Little was known as the author of "Mount Omi and Beyond," "Through the Yangtse Gorges," and "The Far East." He explored the confines of Tibet both from the Chinese and Himalayan sides.

THE Astronómical and Astrophysical Society of America will hold its next meeting, in the summer of 1909, probably at the Yerkes Observatory. Acording to *Science*, the exact date has not yet been fixed, but it is expected to precede by a few days the Winnipeg meeting of the British Association, which will open on August 25, 1909.

A CONFERENCE of fruit-growers will be held at the South-Eastern Agricultural College, Wye, on Friday, November 27. The chair will be taken by Mr. C. W. Radcliffe Cooke, and among the subjects to be discussed are insecticides, by Mr. S. Pickering, F.R.S., and spraying and spraying machinery, by Mr. E. S. Salmon.

PLANS for a new Norwegian Polar expedition were described by Captain Amundsen at a large meeting of the Geographical Society held at Christiania on November 10, and attended by the King of Norway. From the *Times* we learn that Captain Amundsen's plan is to go with Dr. Nansen's old ship the *Fram* to Cape Barrow, the northernmost point of Alaska, and thence north. The ship will drift with the ice across the Polar ocean. The *Fram* will carry provisions for seven years, but the voyage is expected to last five.

ON November 6 an inaugural meeting of the new Aëroplane Club was held in London, when it was decided to form a club devoted to the development of aërial navigation by machines heavier than air. A small provisional committee was appointed to submit to the club the names of gentlemen for service on a general committee.

THE Paris correspondent of the *Times* reports that M. Barthou, the French Minister of Public Works, announced in the Senate on November 5 that the sum of 4000*l.* is to be devoted by his department to the encouragement of aërial locomotion. From the same source we learn that the International Sporting Club of Monaco has offered the sum of 4000*l.* to be competed for at an international aëronautical meeting to be held at Monaco from January 24 to March 24, 1909. The length of the course will be about six miles. The first prize will be 3000*l.*, the second 600*l.*, and the third 40*l.*

IT is with regret that we announce the death of Dr. John M. Thome, the indefatigable director of the Cordova Observatory, who since the retirement of Dr. Gould conducted the work of that institution with marked ability and success. By his loss science is deprived of an ardent and able observer, one who was willing to forsake the more attractive departments of astronomical research and to labour at the very necessary drudgery connected with the compilation of a southern Durchmusterung and similar work, necessitating the wearying and continual repetition of the same process. In some directions sufficient recognition has not been made of the assiduous efforts of Dr. Thome to carry on the work of the observatory with the efficiency and with the magnificent output that characterised Dr. Gould's enterprising direction, and unfortunately in this place we have not room to do justice to his twenty-three years' administration. A very limited acquaintance with the volumes issued from the Argentine Observatory must convince anyone, not only of the value and amount of observation that has been accomplished, but of the difficulties against which Dr. Thome continually struggled. A possibility of war has more than once been made the excuse by the Minister of Public

instruction for reducing the staff, and we can well sympathise with the director in his endeavour to maintain the activity and honourable record of the institution with a diminishing staff consequent upon a vanishing budget. Trustworthy services by competent assistants could not be secured, and the energies of the director had to be devoted to examining and correcting the operations of those who were both inefficient and negligent. We may record, however, his own statement made in 1904, which shows that under his administration there had been produced four volumes giving the places of 630,000 stars with their magnitudes, resulting from more than 1,800,000 observations, together with eighteen charts containing 550,000 stars. These figures are quite sufficient to demonstrate his industry, but if we remember that in addition to this work Dr. Thome cheerfully gave aid in the matter of photographing a zone of the Astrographic Chart, it will be admitted that an amount of work stands to his credit which entitles him to rank among the earnest and devoted supporters of astronomical science.

ANOTHER astronomer who has passed away after rendering long and efficient services is Mr. Andrew Graham, whose name was familiar to two generations of scientific workers, for nearly seventy years have elapsed since he began his astronomical career at Colonel Cooper's observatory at Markree, in Ireland. It was Mr. Graham's fortune to take part in two movements, which have had unexpected developments—the discovery of asteroids and the construction of a Durchmusterung. Before the number of small planets had reached double figures he added Metis to the list, and he lived to see the number grow inconveniently large. The zones of ecliptic stars observed at Markree were among the early efforts of a mode of observing which has since been extended to the whole heavens, to the great advantage of astronomy and the convenience of observers. It was fitting that he who had laboured at the pioneer work of determining approximate positions should end his career by sharing in the magnificent task of giving accurate places to the stars contained in Argelander's survey. For nearly forty years Mr. Graham worked at the Cambridge Observatory under Prof. Adams, during which time he devoted himself with unwearying zeal mainly to the observation of the zone allotted to the Cambridge Observatory in the scheme inaugurated by the Astronomische Gesellschaft. At the advanced age of ninety-three this industrious astronomer has departed, mourned by many friends in the University of Cambridge, where his long services were gratefully acknowledged, and where his memory will long be treasured.

WE have to acknowledge the receipt from the authors, Messrs. Gibbs and Barraud, of a copy of a paper, from the Transactions of the Hertfordshire Natural History Society, on the two-winged flies of that county.

To Captain S. S. Flower we are indebted for a copy of a list of the zoological gardens of the world, drawn up by himself, and published in Egypt. The number of such gardens is eighty.

AN association has been established in connection with the Norwich Museum, of which the first report is now before us. Its object is to arrange demonstrations illustrative of economic natural history and horticulture. A considerable number of such exhibits was displayed during last year, and apparently aroused a fair amount of public interest.

FOR the last few years the council of the Natural History Society of Northumberland, Durham, and Newcastle-on-Tyne has had to record a decrease in the membership roll of that body. In the report for the past year it is satisfactory to see that a slight increase is recorded in this respect, although a considerable addition is required in order to put the society on a satisfactory footing. The list of additions to the museum is comparatively large.

A FINELY illustrated account, by Mr. F. Heatherley, of a visit to the ternery at Wells-by-the-Sea forms the opening article in the October number of the *Zoologist*. Two species are found nesting on this site, namely, the common and the lesser tern; they have separate colonies of their own, probably for the reason that they would disagree if mixed. The author adds that the common tern, when on the wing, may be distinguished from the Arctic tern by its much less jerky flight and its habit of hovering, in kestrel-fashion, when fishing. It is also reported to carry its tail closed more frequently than is the case with the Arctic species.

WE have received copies of the second parts of the *Sitzungsberichte* and of the *Verhandlungen* for 1907, issued by the Naturhistorischen Vereins der preussischen Rheinlande und Westfalens. The former contains a large number of short articles, mainly devoted to local zoology, botany, palæontology, and geology, and to refer to any of these separately would appear invidious. The *Verhandlungen* comprise five longer papers, also mainly on local subjects, Mr. R. Schaufs discussing the copepods and cladocerans of the Bonn district, Mr. K. Röttgen the coleopterous fauna of the Rhine province, Mr. W. Bruhns volcanic bombs from Schweppenhausen, and Mr. A. Hasebrink the Cretaceous formation of the Teutoburg Forest.

THE various methods of developing and preparing fossils for exhibition or for the purpose of study are discussed at considerable length by Dr. F. A. Bather in a paper read before the Ipswich Museums' Conference, and published in the September issue of the *Museums Journal*. In cases of hard and intractable matrix something may in certain instances be accomplished by purely physical methods, such as heating limestones and then plunging them into cold water, by splitting ironstone nodules with the aid of a freezing mixture, or by saturating the rock, when sufficiently porous, with a quickly crystallising solution like magnesium sulphate, when the act of crystallisation loosens the particles of the superficial layer. In other instances, however, it is necessary to resort to chemical agents of various kinds.

To the September number of the *American Naturalist* Prof. T. D. A. Cockerell contributes a paper on some of the results of the expedition sent from Colorado to collect the Tertiary fossils of Florissant. In addition to the large number of species of insects, one of the most interesting fossil types obtained is *Trichophanes foliarum*, an aberrant fish of the perch group originally described from Nevada. In Florissant these fish apparently lived in open water during the great glaciation, entirely cut off from the southern fauna; they were accompanied by another waning type—a species of bowfin (Amia). As regards the flora, the great problem to be determined is whether certain leaves indicate representatives of the Proteaceæ, a group now confined practically to the southern hemisphere. As in the case of the European fossils which have been assigned to the same group, no one, according to the

author, can say definitely that these remains are not proteaceous. If they be referable to that group, we have, in Prof. Cockerell's opinion, further evidence of a land-connection between the great southern continents. In our own view this is not so, as the supposed Proteaceæ might apparently have travelled from north to south along the main continental lines.

IN describing the skull of a domesticated dog from a prehistoric station of the Hallstatt period, near Karlstein, Amtsgericht Reichenhall, Dr. T. Studer (*Mitt. naturfor. Ges. Bern.*, 1907, p. 155) takes the opportunity of reviewing the state of our knowledge of prehistoric dogs generally. In the Palæolithic epoch we have *Canis poutjatini*, an animal of the size of a German sheepdog, with all the general characters of *C. familiaris*, but showing affinity with the dingo of Australia and *C. tenggerianus* of Java. This dog probably lived with Palæolithic man in a half-wild condition, and by crossing with the wolf seems to have given rise to a breed like the "laiki" of Siberia, this being represented by *C. inostranzewi* of Lake Ladoga and the Phalbauten of Lake Neuenburg, while by a cross with a flat-headed wolf arose the Neolithic *C. leineri*, the ancestral form of the modern deerhounds. In another line we have from *C. poutjatini* the sheepdogs, and in yet another the hound group, the earliest representatives of which are *C. matris-optimae* and *C. intermedius* of the Bronze age. Perhaps by further crossing with the wolf or with *C. inostranzewi* was produced the small *C. familiaris palustris* of the Pfahbauten. Crossing of the larger breeds, aided perhaps by intermixture with high-skulled wolves, gave rise to the boarhound group, to which the Karlstein skull pertains, this group not making its appearance until the Glacial period. The group seems to have been characteristic of the Alpine region, where it is still represented by the St. Bernard.

THE whole of the conjoint issue of Nos. 1–3 of the *Bulletin de la Société Impériale des Naturalistes de Moscou* for 1907, comprising 430 pages and six plates (which has just been issued), is devoted to a paper by Prof. A. N. Sewertzoff, of St. Vladimir University, Kiew, on the development of the muscles, nerves, and limbs of the lower four-limbed vertebrates, with special reference to a theory relating to the pentadactylate extremities of vertebrates in general. The author claims to be the first to have investigated the subject from the point of view of the muscles and nerves, previous workers having confined their attention to the skeleton. It is considered that in the ancestral Tetrapoda (Protetrapoda) the skeleton of the free extremities was composed of a small number of skeletal rays, probably not exceeding seven, such a type of extremity being evidently derived from a sparsely rayed fin. On the pre-axial side the number of rays (four) must have been greater than on the post-axial (two). Each ray was segmented, and consisted of a large number of similarly formed short elements, such elements being most numerous in the main axis and least so in the peripheral rays. The main axis of the protetrapodous fin formed a right angle with the spinal axis. In many respects the fore-fin of Ceratodus approximates to this ancestral type, but it must be assumed that the Tetrapoda are derived from a form in which the fins had a horizontal direction. Such a direction probably existed in the ancestors of Ceratodus, whence it may be inferred that the extremities of the Pentadactylia and the Dipnoi have had a divergent evolution. Accordingly, it seems probable that the pentadactylate extremity has been evolved from a "dipnopterygium" which was specialised towards the Ceratodus type. The resemblance to the latter may, indeed, be partly due to convergence, but the author is nevertheless convinced that Dipnoi and Tetrapoda have been evolved from the same stock.

AN article by Dr. A. J. Ewart, published in the Proceedings of the Royal Society of Victoria (vol. xxi., part i.), deals with the longevity of seeds, and touches on several interesting side-points. The summary of a long list of germination tests shows that a large number of leguminous seeds are macrobiotic, that is, they maintain their vitality for a long period; outside this family comparatively few seeds, and those chiefly belonging to the mallow and myrtle orders, could be so described. A marked feature of most macrobiotic seeds is an impermeable coat, shown by Miss J. White to be supplied by the cuticle. The best method of inducing germination in the case of hard-coated seeds consists in steeping the seeds in sulphuric acid for a few hours.

THAT the breeding of plants with the object of tracing the results of specific raisings or crosses requires very elaborate precautions will be patent to anyone who has contemplated such work. Dr. G. H. Shull contributes an article to the *Plant World* (vol. xi.) on pedigree culture, in which he describes the precautions taken at the Station for Experimental Evolution. The soil for the cultures is sterilised in autoclaves, surface watering of the seed-pans is avoided so far as possible, and paraffin bags are used for covering up the flowers. No less important than the cultural details are the labelling of specimens and the registration of records, on which subjects the author offers some suggestions.

THE part (No. 8) of the *Kew Bulletin* recently issued is assigned to two extensive systematic articles on the Gentianaceæ; the former, contributed by Dr. A. W. Hill, deals with the genera Sebæa and Exochænium; the latter, by the director, Lieut.-Colonel Prain, traces the limits of the genera Chironia and Orphium. A note records the identification of two new rubber-yielding plants from Madagascar as *Plectaneia elastica* and *Mascarenhasia lisianthiflora*, both apocynaceous genera, but neither species appears to have much economic value.

A VOLUME of the *Memoires du Comité géologique de Russie* (part xxxviii.) is devoted to the description of certain Jurassic plants from the Caucasus and Turkestan, prepared by Prof. A. C. Seward. The collections from the Caucasus include impressions of Equisetites, also fertile and sterile fronds of *Klukia exilis*, *Marathiopsis Muensteri*, and a new species of Zamites. Among the Turkestan specimens, well-preserved casts provide the material for a new species, *Equisetites ferganensis*; the others are chiefly fronds of ferns such as Cladophlebis and Coniopteris, but some fragments are referred to Ginkgo and coniferous genera.

WE have received a fine *opus* registered as vol. xxv., article 19, of the Journal of the College of Science, Tokio University, in which Mr. B. Hayata describes certain flowers collected on Mt. Morrison and other slopes of the Formosan range. Some of the collections are not yet worked out. The determinations furnish indication of careful compilation, the printing is generous, and the plates form an admirable contrast to many inferior process illustrations now too often provided. The conifers supply the most notable group, as they include a Libocedrus, two new species of Juniperus, a new and only

the second species of Cunninghamia, and the genus Taiwania, fully described elsewhere. The list contains several species, some new, under the genera Quercus, Gentiana, Rhododendron, Hydrangea, and Clematis. The discovery of a species of the American genus Oreopanax is extraordinary. The general affinities lie with the flora of southern and central China, and even more closely with the flora of Japan.

THE report on rainfall registration in Mysore for 1907 has been sent to us by Mr. N. V. Iyengar, chief observer in charge. The average rainfall over the whole of the province during 1907 was 6·6 per cent. in excess of the mean for the last thirty-eight years; this result was chiefly due to excessive rainfall in the Shimoga and Kadur districts. The actual rainfall of the year 1907 and the average for 1870–1907 are exhibited cartographically, and the whole work gives evidence of careful preparation.

WE have received the Bulletins of the Philippine Weather Bureau for September and October, 1907, prepared under the direction of the Rev. Father Algué. In addition to daily and monthly means, earthquake reports, and agricultural notes for a number of stations in the archipelago, they contain much useful information relating to the meteorology of a large portion of the North Pacific, for the net-work of the service includes stations far to the east, in the W. Caroline and Ladrone Islands. These outlying stations make it possible to announce the existence of typhoons in the Pacific long before their influence is felt to any extent in the Philippines, and to send useful warnings to other organisations in the Far East. Tracks of four such cyclonic storms which occurred in September are plotted, all of which re-curved at great distances from the Philippines. The disastrous typhoon which visited Hong Kong on the morning of September 18, 1906, without having given on the previous evening indication of its approach, has led the watchful observers at Manila to add an electrical alarm attachment to their mercurial barograph. This invention is fully described, with illustrations, in the October bulletin. At the close of the day the attachment is so adjusted that "the forecaster may retire for the night with the assurance that he will be warned faithfully in case the barometer should take a sudden plunge downward."

IN NATURE of July 16 we reviewed the report of the Japanese Earthquake Investigation Committee on the secondary oscillations of oceanic tides. The last number of the *Bollettino della Società Sismologica Italiana* (vol. xii., No. 11) contains a memoir on the same subject, by Dr. E. Oddone, whose researches had been carried out independently, and communicated to the society before the publication of the Japanese report. Dr. Oddone recognises the fact that these secondary oscillations, as well as the seiches of lakes, can only exist when they synchronise with the natural period of vibration of the water contained in the bay or lake, but points out that if this were the only controlling factor, and the phenomenon merely one of resonance and the selection of vibrations, we should find seiches and secondary tidal oscillations of every period. He asserts that this is not the case in nature, and that on tabulating all the periods which have been observed they are found grouped in the neighbourhood of a period of sixty-six minutes or of its harmonics; as sixty-six minutes is the calculated period of elastic vibration of the earth as a whole, and the periods most frequently observed in the secondary tidal undulations and seiches agree with those which, in another memoir, Dr. Oddone had indicated as seismic constants, he comes to the conclusion that the exciting cause of both seiches and of the secondary undulations of the tides is to be found in the deformation of the earth as a whole, which, acted on by some internal or external force, tends to take on an elastic vibration of a constant period uninfluenced by the nature of the exciting cause. These vibrations are communicated to bodies of water, and reinforced when the natural period of oscillation of one or more sections of the basin corresponds to generating rhythm or one of its harmonics. Whether this conclusion is accepted or no, the paper is a suggestive one and useful, if only for its summary of the published researches and observations on the subject with which it deals.

THE most important contribution to the second issue of the Bulletins and Memoirs of the Société d'Anthropologie of Paris for the current year is an elaborate paper by Dr. Rivet, in which he sums up the results of the discussions on the remains of primitive man discovered in 1843 in a cave near Lagoa Santa, Minas-Gérães province, in the upper San Francisco basin of Brazil. In all eighteen skulls, the majority of which are in the Copenhagen Museum, are available for examination. Unhappily the age of the remains discovered by Lund cannot be clearly fixed; but from the associated fauna they may be assigned to the Pliocene or post-Pliocene period. In general, the skull form is dolichocephalic. Dr. Rivet enters upon an elaborate comparison of these specimens with those of the allied Paltacalo group. He attempts to show, with some measure of success, that these remains represent the primitive inhabitants of Southern and Central America, these having been dispersed by an intruding race into the outlying districts in Brazil, Patagonia, Chili, and California, where their physique was to some extent modified by their later environment. There is, perhaps, no part of the world where our information regarding primitive man is more deficient than in the region covered by this contribution; and it can hardly be said that the skulls available for examination are sufficient to support far-reaching speculations. It may be hoped that further craniometrical evidence will soon become available to supplement the material which the writer has collected with such devoted labour.

THE Government Museum and Connemara Library at Madras, under the management of Mr. E. Thurston, continues to make satisfactory progress. One of the most interesting features of the museum is the extensive ethnographical collections which have been made by the curator in the course of his annual tours. Southern India is particularly rich in examples of demon-worship, sorcery, and magic. Among recent acquisitions is a remarkable example of sympathetic magic in the shape of a wooden representation of a human being which was washed ashore on the coast near Calicut. The figure is made of soft wood, and is eleven inches in height. The arms are bent on the chest, and the palms of the hands are placed together, as in the act of saluting. A square cavity, closed by a wooden lid, has been cut out of the middle of the abdomen, and contains tobacco, narcotic hemp, and hair. An iron bar has been driven through the body, and terminates in the abdominal cavity. A sharp cutting instrument has been driven into the chest and back in twelve places. A similar figure, life-size, was washed up on the same coast some years ago, and is figured in Mr. Thurston's "Ethnographic Notes in Southern India" (plate xix.). These figures seem to be peculiar to the Laccadive Islands, the people of which are notorious sorcerers. They apparently represent persons possessed by an evil spirit, which is

symbolically nailed to the figure, with certain offerings of propitiation, before the latter is flung into the sea, in order to free the islands from its presence. The theory that spirits can be shut up in jars or figures is familiar in the tale of the Jinnee in the "Arabian Nights," and is accepted by savages and semi-savages in many parts of the world.

OWING to the enormous reduction in the price of aluminium which has recently taken place, it seems quite likely that this metal will be largely employed instead of copper in many instances, for example, as a conductor, and it is also probable that it will be used in place of tin. At one time it was a difficult matter to roll out very fine sheets of aluminium, but further experience has enabled the manufacturers to roll sheets even finer than that of the ordinary tin foil. Aluminium rolled out in this manner will probably in the near future replace tin foil for a great many purposes, for example, the covering of chocolates and food-stuffs, also for wrapping up materials for keeping out damp. Tin is, at the present, about double the price of aluminium, and it has, furthermore, to be borne in mind that the specific weight is about one-eighth that of tin, consequently, weight for weight, it is possible to roll out eight times the number of sheets from aluminium to what could be obtained from tin. Tin salts are more or less poisonous, whereas aluminium salts, at any rate in small quantities, are practically harmless, so that children eating sweetmeats from which they have not taken the trouble to remove the tin foil might do themselves considerable harm, but if aluminium were substituted for tin the chances of doing themselves ill would be far less.

THE relatively high electrical resistivities of alloys as compared with the resistivities of their constituents has been attributed in succession by Lorenz, Ostwald, Rayleigh, and Liebenow to the thermoelectric effects produced by the passage of the current through minute layers of the constituents of the alloy arranged in series with each other. Herr E. L. Lederer, of the University of Prague, has determined the resistances of wires of a number of alloys by the bridge method and by measuring the heat developed in the wires by means of a calorimeter. His results are given in the February number of the *Sitzungsberichte* of the Academy of Science of Vienna, and the resistances determined by the two methods appear to agree to within less than 1 per cent. Herr Lederer concludes that the thermoelectric theory of resistivity of alloys is therefore untenable.

IN our account of the "Mathematics and Physics at the British Association," Prof. Lamb is credited with saying (NATURE, November 5, p. 24):—"The daily variation of temperature is not harmonic, and when it is analysed there is a definite component with a half-day period. The objection to attributing the semi-diurnal pressure variation to this is that the latter is extremely regular, while the temperature variation changes considerably with the locality." Prof. Lamb writes to us to explain that this contains a passage which conveys a rather different meaning from what he (at any rate) intended to say. He does not think there is any valid objection to attributing the semi-diurnal pressure variation to the semi-diurnal component of temperature vibration on the above-stated ground. "A forced oscillation whose amplitude is exaggerated owing to the near coincidence of its period with a free period has necessarily all the simplicity and regularity of the corresponding free mode." We are glad to have the opportunity of correcting our report in accordance with this communication.

ALTHOUGH the study of the refractive indices of gases may be expected to lead to theoretical conclusions of great importance, no very definite conclusions have been drawn until recently from the existing experimental data. This is partly due to the delicacy of the physical measurements involved, but chiefly owing to the difficulty of obtaining the gases in a pure state. The first regularity in the refractivities of a series of chemical gaseous elements was pointed out by Mr. C. Cuthbertson in connection with the argon group, and in the current number of *Science Progress* he gives a clear and interesting *résumé* of the present state of knowledge as regards gaseous refractive indices. The refractivities of the five gases helium, neon, argon, krypton, and xenon are found to be almost exactly in the ratios of 1, 2, 8, 12, and 20, and Mr. Cuthbertson has detected a similar set of ratios in other chemical groups, notably in the halogen and oxygen groups. There can be no doubt that the discovery of the cause of this simple numerical relation will throw light on the structure of the atoms. As is pointed out in the article, there is still room for much experimental work, some of it of a high order of difficulty, before the true meaning of these remarkable relations can be elucidated.

MESSRS. GEORGE ROUTLEDGE AND SONS, LTD., have published a second edition of "The Case for the Goat, with the Practical Experience of Twenty-five Experts," edited by "Home Counties." This edition includes some new data on goat-keeping and new illustrations, while the opportunity has been taken to make various emendations.

WE have received from Messrs. E. and F. N. Spon a copy of the second edition of Mr. C. J. Woodward's "A B C Five-figure Logarithms for General Use." In this edition an index has been given on the inside pages of the cover to find the page on which a given logarithm of an arc function will be found, and a table of natural arc functions to each minute of arc to four places of decimals has been added. The price of the volume is 3*s.* net.

THE fourth part of the first volume of Proceedings of the Association of Economic Biologists, that for September, 1908, is now available. It is chiefly devoted to the papers read at the meeting of the association held in London on April 15 of this year, and reported in our issue of April 23. The number also contains a summary of a meeting held on July 4, and the annual report.

A SERIES of excellently produced catalogues has been received from Messrs. Ross, Ltd., of New Bond Street and Cockspur Street, London. Catalogue No. 1 deals with photographic lenses; field, studio, and hand cameras; lanterns, and the numerous miscellaneous accessories required by the photographer. The price of this catalogue is one shilling. A second booklet is entitled "Aids to Vision for Naval and Military Officers, Sportsmen, Naturalists, &c.," and is devoted to descriptions, with prices, of such instruments as prism binoculars, field glasses, telescopes, sextants, magnetic compasses, barographs, and barometers. The remaining pamphlet, called the "Ross Bird-stalker," is a report by Mr. Charles Dixon on the advantages, possibilities, and uses of the Ross prism binocular, as applied to field natural history. All the catalogues include, in addition to the more usual illustrations of instruments, numerous beautiful process pictures of objects and scenes reproduced from photographs.

OUR ASTRONOMICAL COLUMN.

COMET MOREHOUSE, 1908c.—Numerous results of observations, appearing in several journals, indicate that in comet 1908c we have one of the most interesting cometary visitors that has been discovered of late years.

In the *Comptes rendus* for October 26 (p. 730, No. 17) M. Borrelly describes the observations made at the Marseilles Observatory between September 12 and October 3, and states that his photographs bear evidence of striking changes in the form and extent of the tail system. On September 20 two branches of the tail were shown, one rectilinear, the other curved, and the general appearance resembled that of Donati's 1858 comet; on September 28 the double tail was 5° in length, but on October 2, although triple, it was much shorter. Five tails were shown on the plate of October 3, and the trail of an occulted star indicates a slight absorption effect.

According to M. L. Rabourdin, observing at Meudon, great changes took place from one day to the next, and obvious changes were observed even during the course of an hour; on several plates the tail has an undulating appearance.

Changes, similar to those recorded above, are described by M. Gautier in No. 4278 of the *Astronomische Nachrichten* (p. 97, October 29). The observations were made at the Geneva Observatory during the period October 14–18.

According to a letter to Mr. H. C. Plummer, which appears in the *Observatory* (No. 402, p. 423, November), Prof. Barnard followed the comet closely from September 2 to October 13, and got one or more photographs on each of thirty nights during that period. He states that the photographs of September 30 are unique, whilst the transformation, which took place between the taking of them and the taking of his next one on October 1, was very wonderful. Fortunately there is a Greenwich photograph taken during the interval.

We give below a further extract from Prof. Kobold's ephemeris :—

Ephemeris 12h. M.T. Berlin.

1908	α (true) h. m.	δ (true) ° ′	1908	α (true) h. m.	δ (true) ° ′
Nov. 12 ...	18 52·5 ...	+8 46·3	Nov. 22 ...	18 50·8 ...	−0 21·2
14 ...	18 52·0 ...	+6 45·0	24 ...	18 50·7 ...	−1 55·0
16 ...	18 51·6 ...	+4 50·0	26 ...	18 50·5 ...	−3 24·7
18 ...	18 51·3 ...	+3 0·8	28 ...	18 50·4 ...	−4 50·3
20 ...	18 51·0 ...	+1 17·3	30 ...	18 50·4 ...	−6 12·6

DONATI'S COMET AND THE COMET OF 69 B.C.—Following up the suggestion that Donati's comet (1858 VI.), of which the period is probably something like 2000 years, was identical with the great comet recorded in the Chinese annals as having appeared in 69 B.C., Herr Kritzinger has compared the available data, and finds that the elements differ so much, especially in the inclination of the orbit plane, that the identity cannot be maintained. In fact, the Chinese comet cannot be identified with any later bright comet. Of all the earlier comets, it appears that the one recorded in China in 146 B.C. is the most likely to correspond with Donati's, but the identity is, at the best, very uncertain (*Astronomische Nachrichten*, No. 4277, p. 65, October 20).

TERRESTRIAL ELECTRICITY AND SOLAR ACTIVITY.—In No. 15 of the *Comptes rendus* Dr. A. Nodon reports that on October 2 his instruments at the Bordeaux Observatory indicated a violent change in the terrestrial electrical charge, and states that this change coincided with the passage of an area of solar activity. He further directs attention to the fact that the changes preceded a violent cyclone, which devastated Guadeloupe, and a magnetic storm, which was registered strongly at the Parc Saint-Maur Observatory.

THE "ASTRONOMISCHEN GESELLSCHAFT" AT VIENNA.—The twenty-second general meeting of the "Astronomischen Gesellschaft" was held at Vienna on September 15–18, and a report of the proceedings, contributed by Prof. Kobold, appears in No. 4277 of the *Astronomische Nachrichten* (p. 71). A proposal to hold the 1910 meeting either in America or at Breslau was discussed, the assembly deciding in favour of the latter.

NEW CATALOGUES OF PROPER MOTIONS.—In No. 4276 of the *Astronomische Nachrichten* (p. 49, October 9) Dr. Ristenpart publishes a second list giving the proper motions, in R.A. and dec., of some 150 stars. The usual designation, the position for 1900, the magnitude, and the precession correction for each object are also given.

The first fascicule of vol. iv. of the "Annales de l'Observatoire astronomique de Tokyo" is also devoted to a catalogue of proper motions. In it Mr. K. Hirayama gives the declinations and proper motions of 246 stars employed in the Tokyo latitude observations, and discusses at length the processes by which they have been determined; the present discussion only includes stars not given in the *Jahrbuch*. In the first table the designation and the particulars of each star as they appear in the various catalogues employed are given, whilst the second table includes the resulting declinations and proper motions.

THE INTERNATIONAL CONGRESS ON TUBERCULOSIS AT WASHINGTON.

EVEN in these days of crowded congresses the International Congress on Tuberculosis, held in the last week of September and the first week of October in Washington, must stand out as a most remarkable meeting, especially in point of numbers, and were it not that the work there attempted was largely "educational" in character, and that the arguments and appeals for better methods of combating tuberculosis were directed to a much wider circle than that gathered in Washington, the promoters might well feel that they had undertaken a task for which the return could not be commensurate with the energy they had to expend. There can be no doubt that the congress was far too large to allow of careful and dispassionate discussion of many of the points that were raised in the different sections, but equally there can be no doubt that the moral and educational effect of such a meeting as that held at Washington must be enormous, not only in the United States and Canada, but in every part of the civilised world.

The keynote of the whole meeting was enthusiasm and earnestness combined with thoroughness. Following the lead offered by the British Association in the meetings in South Africa, the congress was divided into a series of peripatetic bands, which, as they made their way to Philadelphia, Washington, and New York, gave addresses and demonstrations on the special topics on which they were authorities. When the congress was over there were innumerable demands (most of which could not be met owing to the fact that the meetings were held so late, and that most of the delegates hastened home to their respective work as quickly as possible) for lecturers to tarry and give addresses in the various eastern towns of the States and Canada. As soon as a number of the French and English delegates arrived in Quebec, Montreal, and Toronto, they were first feasted, and then asked to address municipal bodies, chambers of commerce, boards of trade, and the like, and Dr. R. W. Philip caught the public ear at once by his terse and lucid statement of the Calmette-Philip dispensary system, which has been attended with such marked success in reducing the death-rate from tuberculosis in Edinburgh. At Montreal the way was thus prepared for a great autumn anti-tuberculosis campaign and exhibition, organised by Prof. Adami and his colleagues. Invitations were received from Chicago, Detroit and elsewhere, but the time before the congress was so limited that many of these had to be refused. Exceedingly convenient was the arrangement to hold a meeting of the International Association for the Prevention of Tuberculosis at Philadelphia a week before the actual discussions were to come on in Washington, and great credit must be given to the president, Dr. Lawrence Flick, to Prof. Pannwitz, the secretary, and to the organising committee in Berlin for the excellent programme there presented to the members.

Of course, much time and energy were devoted to the presentation and discussion of reports on sanatoria, on isolation, disinfection, immunisation against, and treatment of, tuberculosis, and it was interesting to note what

efforts are being made by sanitary authorities all over the civilised world to combat this disease. It was realised, as never before, how widespread and serious are the results of tuberculosis, and at the same time how keenly alive, not only the medical profession, but health authorities generally, have become to the importance of dealing even in drastic fashion with the "white scourge." At the end of each day a popular lecture on some aspect of the question was given, these lectures being entrusted to Dr. Pannwitz, on tuberculosis in its social aspects; Dr. Theodore Williams, on the history of the treatment of tuberculosis; and Dr. Calmette, on the tuberculin ophthalmic reaction, with which his name is now so intimately associated. This preliminary conference had a special interest from the fact that it was authoritatively stated that Koch had been somewhat misunderstood at the London congress, and that his position as regards the non-transmissibility of bovine tuberculosis to the human subject was not so directly opposed to what may be called the popular view as had been held to be the case. Needless to say, such an expression of opinion was received with almost a sigh of relief by those who are convinced of the possibility of such communicability. So strongly was the congress impressed with the necessity of ensuring a milk supply free from any possible contamination by tubercle bacilli that on the last day Prof. Heymans, of Ghent, moved, and it was passed with acclamation, that a committee to inquire into the conditions under which milk may become so contaminated be appointed, and that it report at the conference to be held in Brussels in 1910. This committee is thoroughly international, and representative of both the medical and veterinary professions.

During the Philadelphia week large numbers of those specially interested travelled to Washington to inspect the excellent museum that had been brought together by an energetic organising committee under Dr. H. J. Beyer. No such complete, interesting, and instructive exhibition had ever been brought together before, partly because no such material had hitherto been available. It is open to question whether medals and prizes constitute a desirable means of stimulating exhibitors, but in this instance, although we hope that this distribution of prizes will not form a regular feature of these exhibitions, our American cousins may claim that the success that has attended their efforts justifies the means employed. In the matter of prizes, especially money prizes, Great Britain comes out well; Brompton Hospital, represented by Dr. Theodore Williams, Dr. Lathom, and Dr. M. S. Patterson, takes a prize of one thousand dollars offered for the best exhibit of a hospital for the treatment of advanced cases of pulmonary tuberculosis, whilst the one thousand dollar prize offered for the best exhibit of an existing sanatorium for the treatment of tuberculosis amongst the working classes was divided between the Brompton Hospital Sanatorium at Frimley and the Whitehaven Sanatorium at Whitehaven, Pa.

Another prize, part of which came to our side of the Atlantic, was that offered for the best evidence of effective work in the prevention of tuberculosis since the last congress held in Paris three years ago, the Women's National Health Association of Ireland and the committee on tuberculosis of the New York Sanitary Organisation Society dividing both the honours and the money. Other prizes were the first gold medal, awarded to Great Britain, for the best pathological exhibit, and a silver medal to Dr. Sims Woodhead and Mr. William Henman for plans, with elaborate details and descriptions, of a sanatorium. These are given as examples of the range of subjects for which prizes were awarded; but others were an exhibit of the best laws and ordinances in force on June 1, 1908, for the prevention of phthisis, for which the State of Wisconsin was awarded a gold medal, New York City taking a similar award for the best set of laws and ordinances for the prevention of phthisis shown by any municipality in the world, whilst the awards gained by the National Swedish Anti-Tuberculosis Association further illustrate the eclectic character of the exhibits. This association gained two gold medals, one for having the largest number of any organisation in the world which is fighting phthisis, and a second for exhibiting the best plans for raising money with which to wage the crusade against tuberculosis. Again, Dr. D. Sarason, of Berlin, received a gold medal for models and plans showing new and interesting principles in house construction in its relation to the prevention of tuberculosis. These are simply examples of a large number, but they serve to indicate the lines on which the organising committee got together a good museum—by making a definite demand, a demand which in most cases was promptly met from many quarters. Certain of the visitors before seeing the exhibitions scarcely seemed to realise that many of the schemes and plans described in connection with the various American municipalities were anything more than paper plans, but the working plans, models, and statistics soon made it clear that a large amount of very valuable work has been done and effective measures taken to stem the tide of tuberculosis.

Although a great deal of educational work was done in the pathological, clinical, social, surgical, municipal, veterinary, and other sections, there can be little doubt that the centre of interest was the discussion in the combined sections of bacteriology and tuberculosis of animals, at which Prof. Koch maintained that the practical aspect of the question was so important that he felt justified in confining his attention to it. He was satisfied that the tubercle bacilli in bovine tuberculosis were different from those in human tuberculosis, and that although human beings may be infected by the bovine tubercle bacilli, serious disease rarely occurs as a result of such infection. The human bacilli, on the other hand, play a far more important *rôle* in the spread of tuberculosis. He did not claim that the results announced at London were final. He and Dr. Schultz then asked that their experiments should be repeated. Many experiments had been carried on, but he should still like to ask how far sources of error had been eliminated. Animals must be free from spontaneous tuberculosis, the early stages of which cannot be recognised.

Tuberculin, of course, had to be used in connection with this work. Further, it was evident that experiments on too small a series of animals could carry but little weight. Then all animals must be protected from any external infection, especially that of bovine origin, and it was, of course, essential that different series of experiments should be kept absolutely separate. All the infections should be made by subcutaneous injection with early cultures that had not passed through more than a single guinea-pig. He believed that doses of ten milligrams were most satisfactory, and he was satisfied that it was a mistake to use too large doses or to introduce the virus by intravenous or intraperitoneal injection. Of course, there should be no contamination of the cultures. He and his colleague had found that all bacilli from bovine source, when injected into cattle, gave rise to progressive, and ultimately generalised, lesions, but that tubercle bacilli of human origin gave rise to localised and regressive lesions only. He wished to point out, too, that as experiments must necessarily extend over long periods, it was essential during this time to eliminate the possibility of secondary infection. Finally, they had to remember that mixed infection by the human and bovine bacilli might occur.

In regard to the experiments of the British commission, he pointed out that immense quantities of phthisical sputum had been given to calves and pigs, and that it was possible that this sputum had contained milk or butter in which were bovine tubercle bacilli.

The first case to which he referred was placed amongst the positive results. To be of value, he considered that the sputum should have been taken from one case only, and that all possibility of infection by either milk or butter should have been eliminated. He thought the British Royal Commission failed in several respects, and that many of his opponents had not been sufficiently careful on certain of these matters. He maintained that he had never held that we were dealing with two distinct species, but that we had to deal with two different types.

Bearing this in mind, he considered that laboratory experiments, bearing on modification of the characters of

the bacilli, were merely of academic importance, and that any question arising out of them was merely of theoretical value. We had to deal with the properties of "fresh" bacilli, and with these only. He believed that competent investigators were in agreement that the human tubercle bacillus differs from the bovine tubercle bacillus, that this latter does not cause progressive tuberculosis in man, and that, therefore, from the practical point of view, it might be left out of consideration in our crusade against tuberculosis.

Prof. Theobald Smith, though agreeing with certain of Dr. Koch's contentions, was by no means in accord with him as to the sharp line of demarcation that he drew between the human and bovine types of the tubercle bacillus. He believed, moreover, that there was an actual increase of virulence obtained by passage, and that a selective and protective action of the tissues probably comes into play, and he was convinced that increased virulence did not mean change of type.

Prof. Sims Woodhead claimed that in no sense of the word did the members of the British Royal Commission regard themselves as Koch's opponents. He believed they were all working to one end—the elucidation of a problem which Prof. Koch had set before them, a problem he was satisfied they were all anxious to solve, in great measure, too, because of the respect in which they held their great colleague, though even his great authority could not outweigh their own observations and conclusions. In regard to the conditions laid down by Koch, the British Royal Commission had exercised the greatest care to observe each one. Their Government had been induced to spend a very large sum in order to provide sufficient help, and through the patriotic generosity of Lord Blyth a couple of farms, a considerable distance from each other, which could be completely isolated, and a central laboratory between the two, to which material to be worked out could be brought, thus doing away with any necessity for any direct communication between the farms, had been placed at their disposal. As to animals, they were fortunate in having near them an island in which tuberculosis had never yet broken out among the cattle—Jersey—and from which they had been able to obtain a very large supply of bovines on which to carry out their very numerous experiments. They had obtained the assistance of well trained and enthusiastic experts in whom they had every confidence, and the results they had obtained had been set forth in their reports in the greatest detail, so that those who questioned their opinion might see the data on which they were founded, and he asked anyone who read their report to go to the appendix to the report for the details of any case in which they thought there might be any doubt; they might then form their own opinions.

He asked them to accept all this as evidence that they, the commissioners, and their Government were at one with Prof. Koch in looking upon the question as an intensely practical one. They felt that no stone should be left unturned to test the accuracy of statements of such enormous importance, and from the experimental evidence they had been able to obtain they were of opinion that conclusions had been arrived at on quite insufficient data. Prof. Koch had criticised a single one of their experiments. They had taken the utmost care to eliminate the dangers that Prof. Koch had pointed out; but, allowing for a moment that there were flaws in this experiment, one of the earliest that they conducted, he would direct attention to other cases, bearing on the same point, in which he believed they would find no such opening for criticism. It could not be a question of merely "academic" interest when some 30 per cent. of the cases under five years of age reported by the two commissions, the British and the German, were of alimentary origin, for, as calculated by Dr. Cabbett, this meant that about 7 per cent. of the cases of tuberculosis probably resulted from infection from a bovine source, and 7 per cent. of the cases, allowing a little latitude on either side, could not be looked upon as a negligible quantity. Prof. Koch had stated that the alimentary cases were selected, but he should like to point out that at first this was done for a short time because Prof. Koch had been able to find so few cases in Germany. Later they found this unnecessary.

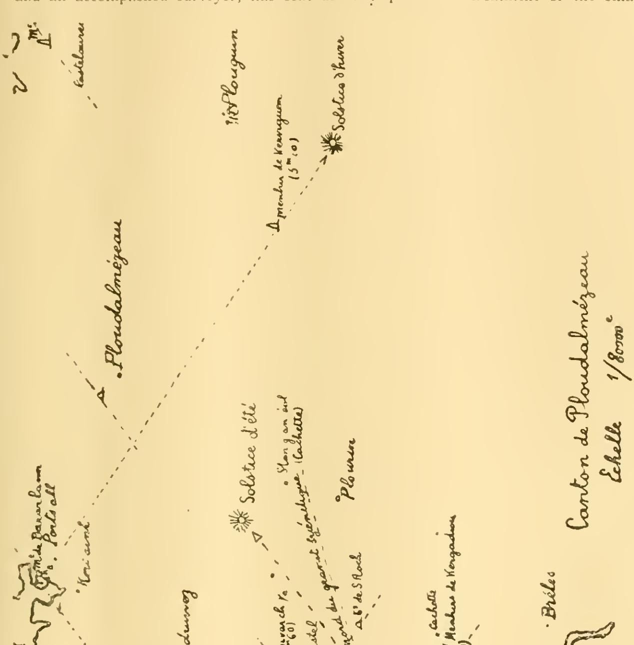
In regard to the question of modification of tubercle bacilli, he was not in a position to say more than had appeared in the report of the commissioners, but he would like to point out that the period after the infection at which the disease manifested itself was so great that many people could not bring themselves to believe that cause and effect were in any way associated, and they scoffed at the idea of tuberculosis being infective. Would not this slow growth place similar difficulties in tracing the modification either of morphological characters or of virulence of the tubercle bacilli? Was it not possible, however, that some of the conditions that regulated the modification of the more rapidly growing bacilli should obtain in the more slowly growing bacilli, allowing, of course, for the much longer period necessary for these modifications to come into effect?

He thought that those who undertook the responsibility of saying that there is no danger to the community, either directly or through an increase of tuberculosis amongst cattle, accepted a very grave responsibility indeed, and for his part he was so impressed by the evidence that had already been obtained, not only in England, America, and Germany, but in France, Denmark, and elsewhere, that he should be loath to countenance the relaxation of a single regulation having for its object the extermination of bovine tuberculosis. Indeed, he would go further, and say that in the interests of the public health still more stringent regulations might have to be put into force.

The outcome of the various discussions may be summed up in the statement that there can be no tuberculosis without the tubercle bacillus, and that although under certain conditions the human subject and the lower animals may resist the invasion of this micro-organism, there are times and conditions in which the vitality and resisting power of the tissues are so greatly impaired that the tubercle bacillus is able to invade the body and cause degenerative lesions in the tissues, and tuberculosis is set up. It was agreed that no hard and fast rule can be laid down for every set of conditions under which the tubercle bacillus is or may be present, but that every means should be taken to kill the bacillus as it comes from any centre of infection before it has had time or opportunity to infect other organisms, and that at the same time all possible means should be taken to raise the insusceptibility or resisting power of any organisms that may be attacked. In open and advanced cases of tuberculosis isolation of the human being and slaughter of cattle are advisable. In the case of cattle an affection of the milk gland should be a sign for the destruction of the animal affected. The sanatorium treatment should be looked upon as being useful from three points of view:—(1) as isolating the patient temporarily; (2) as giving opportunity of instructing the patient as to the best means of disinfecting sputa, &c., which, under ordinary conditions, are a great source of infection; and (3) as commencing the treatment and building up of the patient and educating him as to what, in the interests of his own health, he may do and what he may not. In this connection it may be pointed out that Dr. M. S. Patterson's demonstration of the excellent work that is being done at Frimley was one of the most valuable and instructive lessons given at the congress. He showed that graduated labour seems to help to immunise the patient, to build up his physical powers, to give him confidence, and to improve his morale in so far that, instead of allowing him to degenerate into a valetudinarian, with thoughts only of his own ailments, he receives the inspiration of the knowledge that he can still work and earn his own living, and not only this, but that under proper conditions work is a factor in his recovery. At the present time, when we have promises of legislation in the air, one cannot but feel that those who are responsible for legislation concerning tuberculosis cannot do better than study carefully the results that have been obtained abroad by men perhaps with less experience than ourselves, but also less hide-bound by precedent and tradition than are we. The announcement of the intention of the Local Government Board to enforce compulsory notification of phthisis amongst poor-law patients, for which Dr. Newsholme said he had the authority of the President of the Local Government Board, was received with loud applause at the opening meeting of the congress.

CAPTAIN DEVOIR'S ARCHÆOLOGICAL RESEARCHES IN BRITTANY.

SOME months ago Sir Norman Lockyer directed attention in NATURE (vol. lxxvii., p. 56) to several interesting cases of inter-relation among the stone monuments of Britain. Captain Devoir, a distinguished officer of the French Navy and an accomplished surveyor, has sent us some plans he has recently prepared of a similar inter-relation he has found in Brittany, and among them one in the Canton of Ploudalmézeau. The plan, which he has permitted us to reproduce, shows how all the alignments there are directed to the solstices, or the May-year sun, and that they are continuous over a large stretch of country.



Captain Devoir's map of some of the Brittany alignments.

ANTS AND THEIR GUESTS.

IN a series of papers recently published in the *Biologisches Centralblatt*,[1] Father Wasmann gives us the result of recent elaborate observations and experiments respecting the behaviour of different species of ants living together in the same nest towards each other, and likewise their treatment of the small beetles and other parasites which are in the habit of taking up their abode in ants' nests.

The position of these beetles is very peculiar. By some species of ants they are encouraged and by others they are destroyed, and what is still more remarkable is that some of the beetles which are encouraged and tended by the ants themselves actually feed on the eggs or larvæ of their hosts. The beetles of the genus Atemeles are killed in nests of *Formica rufa* and *F. pratensis*, but they are tolerated in mixed colonies of *F. pratensis* and *F. fusca*, and of *F. rufa* and *F. fusca*. However, as soon as a queen of *F. rufa* was introduced into one of these nests, the Atemeles, which had previously been unmolested, were discarded and massacred. The larvæ of a beetle referred by Wasmann to the genus Lomechusa is extremely destructive to the ant-brood, and although it seems to be tolerated in the nests of *F. sanguinea*, yet its eggs and larvæ seem to be sooner or later devoured by ants of other species if they happen to be found there, and though the perfect beetles do not seem to be molested, they generally die after a few days in nests of other species of ants.

Similar observations on beetles belonging to the genus Dinarda, and on various other ant-guests, including spiders, we will pass over, but the small isopod *Platyarthrus hoffmannseggi* deserves notice. Ants are usually so indifferent to its presence that it has been said they took as little notice of it as if it was invisible, but when a considerable number were introduced into a nest at once (twenty into a nest of mixed *Formica rufa* and *fusca*, or twelve into a nest of *Myrmica laevinodis*) they were at once attacked and massacred by the ants, except a few which were left to live and breed unmolested afterwards. Father Wasmann suggests that in these cases the Platyarthrus might either have been attacked before their peaceable character was recognised, or their sudden invasion in such large numbers may have caused alarm, or they may have brought with them a hostile odour from the ant's nest from which they had been taken.

[1] "Weitere Beiträge zum socialen Paratismus und der Sklaverei bei den Ameisen." Von E. Wasmann, S.J., Luxemburg (*Biologisches Centralblatt*, April 15, May 1, 15, June 1, and July 1).

Other observations on Lomechusa seem to show that the numbers of ant-guests are kept down to a moderate level, and if they become too numerous, they are killed off to reduce their numbers sufficiently to suit the ants, the survivors being protected. Indeed, some of the beetle-guests of the ants may live to the age of two or three years in the nests.

Other observations relate to mixed nests of *Formica exsecta* and *fusca*, which are met with in a state of nature. The development of such colonies, and their generally hostile treatment of Atemeles and other beetles, is discussed in detail.

Further observations relate to experiments on the rearing of other species of worker-pupæ in the nests of *Formica truncicola*, with similar experiments, for comparison, with other ants. While worker-pupæ of *F. fusca* are adopted and reared by *F. truncicola*, those of other species of ants are mostly destroyed, sooner or later, if they are introduced into their nests. It was noticed that some months after the reception of *F. fusca* into one of the nests the queen of *F. truncicola* had become perceptibly darker, but whether this was due to the presence of the darker species (*F. fusca*) or was merely the result of old age requires further investigation. Interesting observations are also recorded respecting the migration of ant colonies, and on their behaviour after the death of the queen.

Another section of the papers is devoted to experiments on the founding of colonies, with special reference to the parasitic and slave-holding species of Formica. Sometimes queens of one species are adopted into the nests of other species, but sometimes they are attacked and killed.

Further observations relate to the founding of colonies of Polyergus, Strongylognathus, and Anergates. Of these, the latter is the most interesting genus. These curious ants develop only into males and females, without workers, and live parasitically in the nests of ants of the genus Tetramorium, where their colonies are met with only rarely, but where they are found they are very numerous. The males are small and wingless. So much was previously known, and Father Wasmann's latest experiments do not throw much fresh light on the subject.

Finally, the author discusses the relationship between parasitism and slavery in ants (which he regards as closely connected), with special reference to Wheeler's views on the subject. These phenomena cannot be explained on phylogenetic principles, on account of the wide differences between the species, which often dwell together in mixed colonies. We have not sufficient space to follow this question further, but strongly recommend students who are interested in ants to wade through Father Wasmann's papers for themselves, for though the observations are sometimes tedious, and seem to us to include a good deal of superfluous detail, yet they include a great amount of material which must be taken into account by all who interest themselves in the numerous problems presented by the habits and psychology of ants.

W. F. KIRBY.

RAYS OF POSITIVE ELECTRICITY.[1]

IN 1886 Goldstein discovered that when the kathode in a discharge-tube is perforated, rays pass through the openings and produce luminosity in the gas behind the kathode; the colour of the light depends on the gas with which the tube is filled, and coincides with the colour of the velvety glow which occurs immediately in front of the kathode. The appearance of these rays is indicated in Fig. 1, the anode being to the left of the kathode KK. Since the rays appeared through narrow channels in the kathode, Goldstein called them "Kanalstrahlen"; now that we know more about their nature, "positive rays" would, I think, be a more appropriate name. Goldstein showed that a magnetic force which would deflect kathode rays to a very considerable extent was quite without effect on the "Kanalstrahlen." By using intense magnetic fields, W. Wien showed that these rays could be deflected, and that the deflection was in the opposite direction to that of the kathode rays, indicating that these rays carry a positive charge of electricity. This was confirmed by measuring the electrical charge received by a vessel into which the rays passed through a small hole, and also by observing the direction in which they are deflected by an electric force. By measuring the deflections under magnetic and electric forces, Wien found by the usual methods the value of e/m and the velocity of the rays. He found for the maximum value of e/m the value of 10^4, which is the same as that for an atom of hydrogen in the electrolysis of solutions. A valuable summary of the properties of these rays is contained in a paper by Ewers ("Jahrbuch der Radioaktivität," iii., p. 291, 1906).

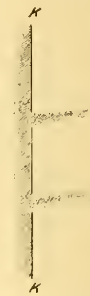


FIG. 1.

As these rays seem the most promising subjects for investigating the nature of positive electricity, I have made a series of determinations of the values of e/m for positive rays under different conditions. The results of these I will now proceed to describe.

Apparatus.

Screen used to Detect the Rays.—The rays were detected and their position determined by the phosphorescence they produced on a screen at the end of the discharge-tube. A considerable number of substances were examined to find the one which would fluoresce most brightly under the action of the rays. As the result of these trials willemite was selected. This was ground to a very fine powder and dusted uniformly over a flat plate of glass. Considerable trouble was found in obtaining a suitable substance to make the powder adhere to the glass. All gums, &c., when bombarded by the rays are liable to give off gas; this renders them useless for work in vacuum-tubes. The method finally adopted was to smear a thin layer of "water-glass" (sodium silicate) over the glass plate, and then dust the powdered willemite over this layer and allow the water-glass to dry slowly before fastening the plate to the end of the tube.

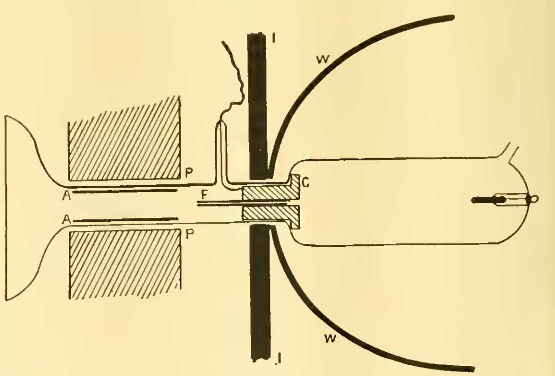


FIG. 2.

The form of tube adopted is shown in Fig. 2. A hole is bored through the kathode, and this hole leads to a very fine tube F. The bore of this tube is made as fine as possible, so as to get a small, well-defined fluorescent patch on the screen. These tubes were either carefully made glass tubes or else the hollow thin needles used for hypo-

[1] Discourse delivered at the Royal Institution by Sir J. J. Thomson, F.R.S.

dermic injections, which I find answer excellently for this purpose. After getting through the needle, the positive rays on their way down the tube pass between two parallel aluminium plates A A. These plates are vertical, so that when they are maintained at different potentials the rays are subject to a horizontal electric force, which produces a horizontal deflection of the patch of light on the screen. The part of the tube containing the parallel aluminium plates is narrowed as much as possible, and passes between the poles P P of a powerful electromagnet of the Du Bois type. The poles of this magnet are as close together as the glass tube will permit, and are arranged so that the lines of magnetic force are horizontal and at right angles to the path of the rays. The magnetic force produces a vertical deflection of the patch of phosphorescence on the screen. To bend the positive rays it is necessary to use strong magnetic fields, and if any of the lines of force were to stray into the discharge-tube in front of the kathode they would distort the discharge in that part of the tube. This distortion might affect the position of the phosphorescent patch on the screen, so that unless we shield the discharge-tube we cannot be sure that the displacement of the phosphorescence is entirely due to the electric and magnetic fields acting on the positive rays after they have emerged from behind the kathode.

To screen off the magnetic field the tube was placed in a soft iron vessel W with a hole knocked in the bottom, through which the part of the tube behind the kathode was pushed. Behind the vessel a thick plate of soft iron with a hole bored through it was placed, and behind this again as many thin plates of soft iron, such as are used for transformers, as there was room for, were packed. When this was done it was found that the magnet produced no perceptible effect on the discharge in front of the kathode.

The object of the experiments was to determine the value of e/m by observing the deflection produced by magnetic and electric fields. When the rays were undeflected they produced a bright spot on the screen; when the rays passed through electric and magnetic fields the spot was not simply deflected to another place, but was drawn out into bands or patches, sometimes covering a considerable area. To determine the velocity of the rays, and the value of e/m, it was necessary to have a record of the shape of these patches. This might have been done by substituting a photographic plate for the willemite screen. This, however, was not the method adopted, as, in addition to other inconveniences, it involves opening the tube and re-pumping for each observation, a procedure which would have involved a great expenditure of time. The method actually adopted was as follows:—The tube was placed in a dark room from which all light was carefully excluded, the tube itself being painted over, so that no light escaped from it. In these circumstances the phosphorescence on the screen appeared bright and its boundaries well defined. The observer traced in Indian ink on the outside of the thin flat screen the outline of the phosphorescence. When this had been satisfactorily accomplished the discharge was stopped, the light admitted into the room, and the pattern on the screen transferred to tracing-paper; the deviations were then measured on these tracings.

Calculation of the Magnetic and Electric Deviation of the Rays.

If we assume the electric field to be uniform between the plates and zero outside them, then we can easily show that x, the horizontal deflection of a ray the charge of which is e, mass m, and velocity v, is given by the equation

$$x=\tfrac{1}{2}X\frac{e}{mv^2}l(l+2d),$$

where X is the force between the plates, l the length of path of the rays between the plates, and d the distance of the screen from the nearer end of the parallel plates.

To find the deflection due to the magnetic field, we have, if ρ is the radius of curvature of the path at a point where the magnetic force is H,

$$\frac{mv^2}{\rho}=Hev,$$

or

$$\frac{1}{\rho}=\frac{e}{mv}H.$$

If y is the vertical displacement of the particle, we have

$$\frac{1}{\rho}=\frac{d^2y}{dz^2}\text{ approximately,}$$

where z is measured along the path of the ray. Hence

$$\frac{d^2y}{dz^2}=\frac{e}{mv}H;$$

$$y=\frac{e}{mv}\left[\int_0^{l+d}\int_0^z H\,dz\right] \quad . \quad . \quad . \quad . \quad (1)$$

In these strong fields there are considerable variations of H along the path, so that to calculate the integrals we should have to map out the value of H along the path of the ray. This would be a very laborious process, and it was rendered unnecessary by the following simple method, which, while not involving anything like the labour of the direct method, gives much more accurate results. The method is shown in Fig. 3. The part of the tube through which the rays pass was cut off, and a metal rod placed so that its tip Z coincided with the aperture of the narrow tube through which the positive rays had emerged. A very fine wire soldered to the end of this tube passed over a light pulley, and carried a weight at the free end. The pulley was supported by a screw, by means of which it could be raised or lowered; a known current passed through the wire, entering it at Z and leaving it through the pulley. The pulley was first placed so that the path of the stretched wire when undeflected by a magnetic field coincided with the path of the undeflected rays. A vertical scale, the edge of which was at the same distance from the opening through which the rays emerge as the screen on which the phosphorescence had been observed, was placed

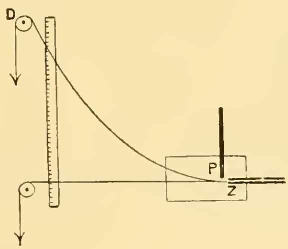


Fig. 3.

just behind the wire, and was read by a reading microscope with a micrometer eye-piece. When the magnetic field was put on, the wire was deflected; and if T is the tension of the wire, ρ the radius or curvature into which it is bent, i the current through the wire,

$$\frac{T}{\rho}=Hi;$$

or, if y_1 is the vertical displacement of the wire,

$$\frac{d^2y_1}{dz^2}=\frac{i}{T}\cdot H$$

Now if $\frac{dy_1}{dz}=0$ when $z=0$ we have, if y_1 is the displacement of the wire at the scale,

$$y_1=\frac{i}{T}\int_0^l\cdot\int_0^z H\,dz \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Hence, comparing (1) and (2) we have

$$\frac{y}{y_1}=\frac{\frac{e}{mv}}{\frac{i}{T}}, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

a relation from which the magnetic force is eliminated. To ensure that the tangent to the wire is horizontal when $z=0$, the following method is used. P is a chisel-edge carried by a screw and placed about 1 mm. in front of the fixed end of the wire; this is adjusted so that when the magnetic field is not on, the wire just touches the edge; this can be ascertained by making the contact with the wire complete an electric circuit in which a bell is placed. When the magnetic field is put on the wire is pulled off from the edge, and the tangent at $z=0$ is no longer horizontal; it can, however, be brought horizontal by raising or lowering the pulley D until the wire is again in contact with P, which can be ascertained again by the ringing of the bell. Then y_1 is the vertical distance between the point where the wire now crosses the edge of the scale and the point where it crossed it before the magnetic field was put on. Since y, y_1, i, and T can easily be measured, equation (3) gives us the value of e/mv, while the deflection under the electric force gives the value of e/mv_2.

If y is the vertical displacement of the patch of phosphorescent light on the screen produced by the magnetic field, x the horizontal displacement due to the electrostatic field, we see that

$$y = \frac{y_1}{\left(\frac{i}{T}\right)} \frac{e}{mv} = B\frac{e}{mv},$$

$$x = A\frac{e}{mv^2},$$

where A and B are constants depending on the position of the screen and the magnitudes of the electric and magnetic forces. These quantities can be calculated by means of the equations just given.

Since

$$\frac{y}{x} = \frac{B}{A}v,$$

$$\frac{y^2}{x} = \frac{B^2}{A}\frac{m}{e}.$$

We see that if the pencil is made up of rays having a constant velocity, but having all values of e/m up to a maximum value, the spot of light will be spread out by the magnetic and electric fields into a straight line extending a finite distance from the origin. While if it is made up of two sets of rays, one having the velocity v_1 the other the velocity v_2, the spot will be drawn out into two straight lines as in Fig. 4.

If e/m is constant and the velocities have all values up to a maximum, the spot of light will be spread out into a portion of a parabola as indicated in Fig. 5.

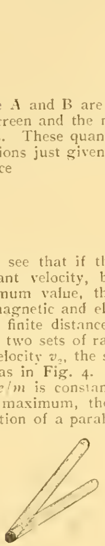


FIG. 4.

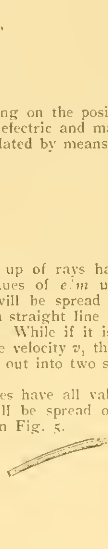


FIG. 5.

We shall later on give examples of each of these cases.

The discharge was produced by means of a large induction coil, giving a spark of about 50 cm. in air, with a vibrating make and break apparatus. Many tubes were used in the course of the investigation; the dimensions of these varied slightly. The distance of the screen from the hole from which the rays emerged was about 9 cm., the length of the parallel plates about 3 cm., and the distance between them 0·3 cm.

Properties of the Positive Rays when the Pressure is not exceedingly low.

The appearance of the phosphorescent patch after deflection in the electric and magnetic fields depends greatly upon the pressure of the gas. I will begin by considering the case when the pressure is comparatively high, say of the order of 1/50 mm. At these pressures, though the walls of the tube in front of the kathode were covered with bright phosphorescence and the dark space extended right up to the walls of the tube, and was several centimetres thick, traces of the positive column could be detected in the neighbourhood of the anode. I will first take the case where the tube was filled with air. Special precautions were taken to free the air from hydrogen; it was carefully dried, and a subsidiary discharge-tube, having a kathode made of the liquid alloy of sodium and potassium, was fused on to the main tube. When the discharge passes from such a kathode it absorbs hydrogen. The discharge was sent through this tube at the lowest pressure at which enough light was produced in the gas to give a visible spectrum, until the hydrogen lines disappeared and the only lines visible were those of nitrogen and mercury vapour. This pressure was a little higher than that used for the investigation of the positive rays, but a pump or two was sufficient to bring the pressure down to this value. The appearance of the phosphorescence on the screen when the rays were deflected by magnetic and electric forces separately and conjointly is shown in Fig. 6.

The deflection under magnetic force alone is indicated by vertical shading, under electric force alone by horizontal shading, and under the two combined by cross shading.

The spot of phosphorescence is drawn out into a band on either side of its original position. The upper portion, which is very much the brighter, is deflected in the direction which indicates that the phosphorescence is produced by rays having a positive charge; the lower portion (indicated by dots in the figure), which though faint is quite perceptible on the willemite screen, is deflected as if *the rays carried a negative charge.* The length of the lower portion is somewhat shorter than that of the upper one, but is quite comparable with it. The intensity of the luminosity in the upper portion is at these pressures quite continuous; no abrupt variations such as would show themselves as bright patches could be detected, although, as will be seen later on, these make their appearance at lower pressures. Considering for the present the upper portion, the straightness of the edges shows that the velocity of the rays is approximately constant, while the values of e/m range from zero at the undeflected portion to the value approximately equal to 10^4 at the top of the deflected band. This value of e/m is equal to that for a charged hydrogen atom, and, moreover, there was no specially great luminosity in the positions corresponding to $e/m = 10^4/14$ and $10^4/16$, the values for rays carried by nitrogen or oxygen atoms, though these places were carefully scrutinised. As hydrogen when present as an impurity in the tube has a tendency to accumulate near the kathode, the following experiment was tried to see whether the Kanalstrahlen were produced from traces of hydrogen in the tube. The discharge was sent through the tube in the opposite direction, *i.e.* so that the perforated electrode was the anode, the electric and magnetic fields being kept on. When the discharge passed in this way there was, of course, no luminosity on the screen; on reversing the coil again, so that the perforated electrode was the kathode, the luminosity flashed out instantly, presenting exactly the same appearance as it had done when the tube had been running for some time with the perforated electrode as kathode.

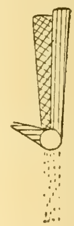


FIG. 6.

The fact that a spot of light produced by the undeflected positive rays is under the action of electric and magnetic forces drawn out into a continuous band was observed by W. Wien, who was the first to measure the deflection of the positive rays under electric and magnetic forces. The values of e/m obtained from the deflections of various parts of this band range continuously from zero, the value corresponding to the undeflected portion, to 10^4, the value corresponding to those most deflected. Wien explained this by the hypothesis that the charged particles which make up the positive rays act as nuclei, round which molecules of the gas through which the rays pass condense, so that very complex systems made up of a very large number of molecules get mixed up with the particles forming the positive rays, and that it is these heavy and cumbrous systems which give rise to that part of the luminosity which is only slightly deflected. I think that

the constancy of the velocity of the rays, indicated by the straight edges of the deflected band, is a strong argument against this explanation, and that the existence of the negative rays is conclusive against it. These negatively electrified rays, which form the faintly luminous portion of the phosphorescence indicated in Fig. 6, are not kathode rays. The magnitude of their deflection shows that the ratio of e/m for these rays, instead of being as great as $1 \cdot 7 \times 10^7$, the value for kathode rays, is less than 10^4. The particles forming these rays are thus comparable in size with those which form the positive rays. The existence of these negatively electrified rays suggests at once an explanation, which I think is the true one, of the continuous band into which the spot of phosphorescence is drawn out by the electric and magnetic fields. The values of e/m which are determined by this method are really the mean values of e/m, while the particle is in the electric and magnetic fields. If the particles are for a part of their course through these fields without charge, they will not during this part of their course be deflected, and in consequence the deflections observed on the screen, and consequently the values of e/m, will be smaller than if the particle had retained its charge during the whole of its career. Thus, suppose that some of the particles constituting the positive rays, after starting with a positive charge, get this charge neutralised by attracting to them a negatively electrified corpuscle, the mass of the corpuscle is so small in comparison with that of the particle constituting the positive ray that the addition of the particle will not appreciably diminish the velocity of the positive particle. Some of these neutralised particles may get positively ionised again by collision, while others may get a negative charge by the adhesion to them of another corpuscle, and this process might be repeated during the course of the particle. Thus there would be among the rays some which were for part of their course unelectrified, at other parts positively electrified, and at other parts negatively electrified. Thus the mean value of e/m might have all values ranging from α, its initial value, to $-\alpha'$, where α' might be only a little less than α. This is just what we observe, and when we remember that the gas through which the rays are passing is ionised, and contains a large number of corpuscles, it is, I think, what we should expect.

At very low pressures, when there are very few ions in the gas, this continuous band stretching from the origin is replaced by discontinuous patches.

Positive Rays in Hydrogen.

In hydrogen, when the pressure is not too low, the brightness of the phosphorescent patch is greater than in air at the same pressure; the shape of the deflected phosphorescence is markedly different from that in air. In air, the deflected phosphorescence is usually a straight band, whereas in hydrogen the boundary of the most deflected side is distinctly curved and is concave to the undeflected position. The appearance of the deflected phosphorescence is indicated in Fig. 7.

The result indicated in Fig. 8, which was also obtained

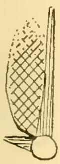


FIG. 7.

FIG. 8.

with hydrogen, shows that we have here a mixture of two bands, as indicated in Fig. 4, the two bands being produced by carriers having different maximum values of e/m. The greatest value of e/m obtained with hydrogen was the same as in air, $1 \cdot 2 \times 10^4$, the velocity was $1 \cdot 8 \times 10^8$ cm. per sec. The presence of the second band indicates that mixed with these we have another set of carriers, for which the maximum value e/m is half that in the other band, *i.e.* 5×10^3. The curvature of the boundary generally observed is due to the admixture of these two rays.

Positive Rays in Helium.

In helium the phosphorescence is bright, and the deflected patch has in general the curved outline observed in hydrogen. I was fortunate enough, however, to find a stage in which the deflected patch was split up into two distinct bands, as shown in Fig. 9. The maximum value of e/m in the band a was $1 \cdot 2 \times 10^4$, the same as in air and hydrogen, and the velocity was $1 \cdot 8 \times 10^8$, while the maximum value of e/m in band b was almost exactly one quarter of that in a (*i.e.* $2 \cdot 9 \times 10^3$). As the atomic weight of helium is four times that of hydrogen, this result indicates that the carriers which produce the band b are atoms of helium. This result is interesting, because it is the only case (apart from hydrogen) in which I have found values of e/m corresponding to the atomic weight of the gas; and even in the case of helium, when the pressure in the discharge-tube is very low and the electric field very intense, the characteristic rays with $e/m = 2 \cdot 9 \times 10^3$ sometimes disappear, and, as in all the gases I have tried, we get two sets of rays, for one set of which $e/m = 10^4$ and for the other 5×10^3.

FIG. 9.

Although the helium had been carefully purified from hydrogen, the band a (for which $e/m = 10^4$) was generally the brighter of the two. The case of helium is an interesting one; for the class of positive rays, known as the α rays, which are given off by radio-active substances, would *a priori* seem to consist most probably of helium, since helium is one of the products of disintegration of these substances. The value of e/m for these substances is 5×10^3, where we have seen that in helium it is possible to obtain rays for which $e/m = 2 \cdot 9 \times 10^3$. It is true that, at very low pressures and with strong electric fields, we get rays for which $e/m = 5 \times 10^3$; but this is not a peculiarity of helium; all the gases which I have tried show exactly the same effect.

Argon.

When the discharge passed through argon, the effects observed were very similar to those occurring in air. The sides were perhaps a little more curved, and there was a tendency for bright spots to develop. The measurements of the electric and magnetic deflection of these spots gave $e/m = 10^4$, the value obtained for other cases. There was no appreciable increase of luminosity in the positions corresponding to $e/m = 10^4/40$, as there would have been if an appreciable number of the carriers had been argon atoms.

Positive Rays in Gases at very low Pressures.

As the pressure of the gas in the discharge-tube is gradually reduced, the appearance of the deflected phosphorescence changes; instead of forming a continuous band, the phosphorescence breaks up into two isolated patches; that part of the phosphorescence in which the deflection was very small disappears, as also does the phosphorescence produced by the negatively electrified portion of the rays.

In the earlier experiments considerable difficulty was experienced in working at these very low pressures; for when the pressure was reduced sufficiently to get the effects just described, the discharge passed through the tube with such difficulty that in a very few seconds after this stage was reached sparks passed from the inside to the outside of the tube, perforating the glass and destroying the vacuum. In spite of all precautions, such as earthing the kathode and all conductors in its neighbourhood, perforation took place too quickly to permit measurements of the deflection of the phosphorescence.

This difficulty was overcome by taking advantage of the fact that, when the kathode is made of a very electropositive metal, the discharge passes with much greater ease than when the kathode is made of aluminium or platinum.

The electropositive metals used for the kathode were:—(1) the liquid alloy of sodium and potassium, which was smeared over the kathode, and (2) calcium, a thin plate of which was affixed to the front of the kathode. With these kathodes, the pressure in the tube could be reduced to very low values without making the discharge so difficult as to lead to perforation of the tube by sparking, and accurate measurements of the position of the patches of phosphorescence could be obtained at leisure.

The results obtained at these low pressures are very interesting. Whatever kind of gas may be used to fill the tube, or whatever the nature of the electrode, the deflected phosphorescence splits up into two patches. For one of these patches the maximum value of e/m is about 10^4, the value for the hydrogen atom; while the value for the other patch is about 5×10^3, the value for α particles or the hydrogen molecule. Examples of the appearance of this phosphorescence are given in Figs. 10, 11, and 12. In Fig. 12 the magnetic force was reversed.

Hydrogen

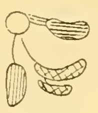


FIG. 10

Helium

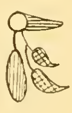


FIG. 11.

Air

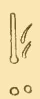


FIG. 12.

The differences in the appearance are due to differences in the pressure rather than to differences in the gas; for at slightly higher pressures than that corresponding to Fig. 12, the appearance shown in Figs. 10 and 11 can be obtained in air. In all these cases the more deflected patch corresponds to a value of about 10^4 for e/m, while e/m for the less deflected patch is about 5×10^3.

It will be noticed that in Fig. 11 there is no trace in the helium tube of rays for which $e/m=2\cdot5\times10^3$, which were found in helium tubes at higher pressures; at intermediate pressures there are *three* distinct patches of helium, for the first of which $e/m=10^4$, for the second $e/m=5\times10^3$, and for the third $e/m=2\cdot5\times10^3$ approximately. Helium is a case where there are characteristic rays—*i.e.* rays for which $e/m=10^4/M$, where M is the atomic weight of the gas, when the discharge potential is comparatively small, and not when, as at very low pressures, the discharge potential is very large. I think it very probable that, if we could produce the positive rays with much smaller potential differences than those used in these experiments, we might get the characteristic rays for other gases. I am at present investigating with this object the positive rays produced when the perforated kathode is, as in Wehnelt's method, coated with lime, when a potential difference of 100 volts or less is able to produce positive rays. The interest of the experiments at very low pressures lies in the fact that in this case the rays are the same whatever gas may be used to fill the tube; the characteristic rays of the gas disappear, and we get the same kind of carriers for all substances.

I would especially direct attention to the simplicity of the effects produced at these low pressures; only two patches of phosphorescence are visible. This is, I think, an important matter in connection with the interpretation of these results; for at these low pressures we have to deal, not only with the gas with which the tube was originally filled, but also with the gas which is given off by the electrodes and the walls of the tube during the discharge; and it might be urged that at these low pressures the tube contained nothing but hydrogen given out by the electrodes. I do not think this explanation is feasible, for the following reasons:—

(1) The gas developed during the discharge is not wholly hydrogen; if the discharge is kept passing long enough to develop so much gas that the discharge through the gas is sufficiently luminous to be observed by a spectroscope, the spectrum always showed, in addition to the hydrogen lines, the nitrogen bands; indeed, the latter were generally the most conspicuous part of the spectrum. If the phosphorescent screen on which the positive rays impinge is observed during the time this is being given off, the changes which take place in the appearance of the screen are as follows:—If, to begin with, the pressure is so slow that the phosphorescent patches are reduced to two bright spots, then, as the pressure begins to go up owing to the evolution of the gas, the deflection of the spots increases. This is owing to the reduction in the velocity of the rays consequent upon the reduction of the potential difference between the terminals of the tube, as at this stage an increase in the pressure facilitates the passage of the discharge. In addition to the increase in the displacement there is an increase in the area of the spots giving a greater range of values of e/m; this is owing to the increase in the number of collisions made by the particles in the rays on their way to the screen. As more and more gas is evolved the patches get larger, and finally overlap; the existence of the second patch being indicated by a diminution in the brightness of the phosphorescence at places outside its boundary. As the pressure increases the luminosity gets more and more continuous, and we finally get to the continuous band, as shown in Fig. 6. At this stage it is probable that there may be enough luminosity to give a spectrum showing the nitrogen lines, indicating that a considerable part of the gas in the tube is air. It is especially to be noted that during this process, when gas was coming into the tube, there has been no development of patches in the phosphorescence indicating the presence of new rays; on the contrary, one type of carrier—that corresponding to $e/m=5\times10^3$—has disappeared. The presence of the nitrogen bands in the spectrum shows that nitrogen is carrying part of the discharge, and yet there are no rays characteristic of nitrogen to be observed on the screen, a proof, it seems to me, that different gases may be made by strong electric fields to give off the same kind of carriers of positive electricity.

Another result, which shows that the positive rays are the same although the gases are different, is the following. The tube was pumped until the pressure was much too low for the discharge to pass, then small quantities of the following gases were put into the tube:—air, carbonic oxide, hydrogen, helium, neon (for which I am indebted to the kindness of Sir James Dewar); the quantity admitted was adjusted so that it was sufficient to cause the discharge to pass, and yet did not raise the pressure beyond the point where the phosphorescence is discontinuous. In every case there were patches corresponding to $e/m=10^4$, $e/m=5\times10^3$, and except with helium these were the only patches; in helium, in addition to the two already mentioned, there was a third patch, for which $e/m=2\cdot5\times10^3$.

I also tried another method of ensuring that at these low pressures there were other gases besides hydrogen in the tube. I filled the tube with helium, and after exhausting to a fairly low pressure by means of the mercury pump, I performed the last stages of the exhaustion by means of charcoal cooled with liquid air. This charcoal absorbs very little helium in comparison with other gases, so that it is certain that there was helium in the tube. The appearance of the phosphorescent screen of tubes exhausted in this way did not differ from those exhausted solely by the pump.

The most obvious explanation of these effects seems to me to be that under very intense electric fields different substances give out particles charged with positive electricity, and that these particles are independent of the nature of the gas from which they originate. These particles are, so far as we know at present, of two kinds; for one kind e/m has the value of 10^4, that of an atom of hydrogen; for the other kind e/m has half this value, *i.e.* it has the same value as for the α particles from radioactive substances.

This agreement in the maximum value of e/m at different pressures is a proof that this is a true maximum, and that there are not other more deflected rays not strong enough to produce visible phosphorescence; for if this were the case—*i.e.* if the value of e/m for a particle that had never lost its charge temporarily by collision were greater than 10^4—we should expect to get larger values for e/m at low pressures than at high.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE New York correspondent of the *Times* announces that Dr. Charles W. Eliot's resignation of the presidency of Harvard University will take effect in May next.

MISS HOLLAND WREN has been appointed by the council of the Pharmaceutical Society demonstrator in the society's School of Pharmacy. This is the first time a woman has been appointed to such a position since the school was established more than sixty years ago.

THE current number of *Child Study*, the journal of the Child Study Society, which is published quarterly, contains an article by Dr. Alex. Morgan, principal of the Provincial Training College, Edinburgh, on child study in relation to the training of teachers. Dr. Morgan thinks there is a tendency to over-estimate the practical utility at the present time of psychology in education, and though he hopes the time will come when we shall have a scientific pedagogy founded entirely on a scientific psychology, he is of opinion that this day is not imminent.

IT is stated in the *Pioneer Mail* that Mr. Chinubhai Madhowlal has given four lakhs of rupees in $3\frac{1}{2}$ per cent. Government securities to be applied by the Government towards the development of science teaching in Ahmedabad, in connection, if possible, with the proposed Curline Institute in Bombay. The Governor, in acknowledging the gift, is reported to have said that the response to his appeal for means to develop science teaching in the Presidency is far more generous than he had dared to hope, and the splendid benefactions, amounting to eighteen lakhs, prove alike the large-hearted patriotism of the givers and their recognition of one of India's greatest educational needs.

THE Department of Agriculture and Technical Instruction for Ireland has re-published in pamphlet form an article by Mr. A. E. Easthope, principal of the technical schools and organising secretary for technical instruction in the county of Louth, on technical instruction in Dundalk. The article originally appeared in the department's Journal (vol. viii., No. 4). This is the sixth of a short series of articles on recently established Irish technical schools. The Municipal Technical School, Dundalk, is housed in a new building specially erected for the purpose, and Mr. Easthope's description and the illustrations of various departments of the school serve admirably to illustrate the progress being made in this department of Irish education.

THE report for the year ending on June 30 last of Mr. Charles Madeley, director and librarian for the Warrington Museum Committee, shows that the educational work in connection with the museum continues to be developed. There was during the year a notable increase in the number of accessions to the museum. Continued interest is taken in the wild-flower table, which is a distinctive feature of the work done at Warrington. The average number of species on view during July to October was 175, the maximum, 200 species, being reached on September 4. In the autumn the flowers were succeeded by fruits and seeds. Personal observation has proved that the number of persons making regular visits for the purpose of studying these plant specimens is on the increase, and the number of inquiries for botanical information continues to grow. Additions have also been made to the specially arranged educational exhibits, particularly in the botanical gallery and the department of invertebrate animals. It is to be hoped that the authorities of more provincial museums may follow the example of Warrington and make their exhibits serve an educational purpose of a definite kind.

THE calendar of University College (University of London) for the session 1908–9 has just been issued. It contains many new features. The outline of the history of the college, by Dr. Carey Foster, has been revised and brought up to date. The calendar also contains a set of plans that show more completely than before the uses to which the extension of buildings is being put. The new buildings have resulted in extended accommodation for the libraries, for the faculty of arts, for the departments of geology, hygiene, experimental psychology, and for each of the departments of the faculty of engineering. The calendar also contains a section setting forth in full the arrangements for post-graduate courses of lectures and the facilities for research work. The regulation with regard to admission is as follows:—"On the recommendation of the professor of any department, any student qualified to undertake research work may be admitted to the college for the purpose of undertaking such work. Each student so admitted shall pay in the office a registration fee of 1*l*. 1*s*. per session, and such other fee (if any) as the regulations of the department may require, and shall bear the cost (if any) of his work." It appears from the summary of students that there were no fewer than 229 post-graduate and research students in the college last session.

THE annual general meeting of the Association of Teachers in Technical Institutions was held on November 7 at St. Bride's Institute, Bride Lane, London. In moving the adoption of the report, Mr. Charles Harrap, the president, congratulated the members on the steady progress which has been made. He went on to say it is time there was a technical college for training teachers. No one knows better than the members of the association how difficult it is to get competent technical handicraft teachers—men who have worked at the trade and know how to teach it. Such men, when found, deserve the best treatment from authorities in order that they may be retained for the benefit of technical instruction generally. Among the difficulties which have to be overcome if English technical education is to be successful is the necessity of obtaining the concurrence of both employers and employees in any scheme intended to substitute trade-school training for part or whole apprenticeship. The London County Council has been able to form two consultative committees, one for the bookbinding and another for the printing trades, each committee consisting of three employers, three representatives of the employees, and three London County Council nominees. One of these committees has completed its preliminary work, and in due course an experimental school is to be tried where lads can undergo a proper preparatory training for the trade. The youths will generally be selected by scholarship tests, and may enter the preparatory trade training school from $12\frac{1}{2}$ years of age. The newly elected president of the association is Mr. J. Wilson, head of the chemical department, Battersea Polytechnic, S.W., who has acted as honorary secretary of the association since its formation in 1904. His successor in that office is Mr. P. Abbott, head of the mathematical department, Regent Street Polytechnic, London, W.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 25.—"Eutectics Research, No 1. The Alloys of Lead and Tin." By Walter **Rosenhain**, with P. A. **Tucker**. Communicated by Dr. R. T. Glazebrook, F.R.S.

Attempts to prepare pure eutectic alloys led to the discovery of discrepancies between the authors' experiments and the data on lead-tin alloys published by Roberts-Austen. The present paper contains an account of the complete re-determination of the equilibrium diagram of the lead-tin series. The eutectic point is now placed at 63 per cent. of tin, and the eutectic line ends, towards the lead end of the series, at 16 per cent. of tin, while a series of transformations in the solid alloys, with a maximum temperature lying at 150° C., has been discovered. By the aid of levigated oxide of chromium the alloys have been polished for microscopic examination, and this has enabled the authors to decide many points with greater accuracy. For the purposes of microscopic examination, and also for cooling-curve purposes, specimens of the alloys were kept at temperatures of 175° C. for periods up to six weeks, and some were quenched in liquid air. Cooling and heating curves ranging down to −180° C. were also taken. By these means it was shown that the transformation above mentioned consists in a change in the solid solution of tin in lead, which passes from a β into an α condition, at the same time rejecting tin from solution.

The structures observed in lead-tin eutectic alloys are described in detail, and evidence is given for the view that this alloy consists of an aggregate of spherulitic crystals. The authors have also examined the structure of "alloys" prepared by the compression of powders (Spring's method), and have found them to consist of aggregates of the original particles in an unchanged condition.

"The Boiling Point of Sulphur on the Constant Pressure Air Thermometer." By N. **Eumorfopoulos.** Communicated by Prof. H. L. Callendar, F.R.S.

The experiments described in this paper were carried out with a view to the re-determination of the boiling point of sulphur, the value (444°·53) previously obtained by Callendar and Griffiths being open to some doubt.

The air thermometer, made of Jena glass 16 III., is substantially that described by Callendar (Roy. Soc. Proc., vol. l., p. 247), except that the final adjustment of pressure is made with the help of an oil gauge.

The formula to be used with this thermometer is shown to take a simple form, the necessary corrections being small. In particular, the uncertainty of the temperature of the "dead space" is eliminated by means of compensated tubes. The sensitiveness of the oil gauge is given for different temperatures, and its diminution with rise of temperature shown to have little practical importance.

All the volume determinations are made with mercury. The expansion of the bulb was obtained by treating it as a weight thermometer, observations being made at 0°, 100°, and 184°. If the Regnault-Broch formula for the expansion of mercury is taken, the experiments lead to the following expression for the coefficient of expansion of the glass,

$$\{23868 + 4 \cdot 20(t - 100)\} 10^{-9},$$

but with Chappuis's value to

$$\{24254 + 23 \cdot 47(t - 100)\} 10^{-9}.$$

Reasons are given for preferring the former value, thus suggesting that the true value for the coefficient of expansion of mercury is still unknown.

The boiling point of sulphur was determined directly on the air thermometer: the mean of the eleven values obtained is, at normal pressure, 443°·62.

The changes of volume of the bulb when heated in sulphur vapour were a source of trouble and some uncertainty, although the bulb had been previously annealed for many hours.

"Note on the Boiling Point of Sulphur." By Prof. H. L. **Callendar,** F.R.S.

One of the chief difficulties in the accurate determination of high temperatures by means of the gas thermometer is the uncertainty of the correction for the expansion of the bulb. The whole correction may amount to as much as 5° C. at 445° C. (the boiling point of sulphur) or 30° C. at 1000° C. The uncertainty of the correction is due to the fact that it cannot be directly determined, but must be inferred from observations of the linear expansion of the material of the bulb, or from observations with a mercury weight thermometer, in which the expansion of mercury is assumed. There are obvious objections to assuming that the cubical coefficient of expansion of an asymmetrical bulb is three times the linear. The method of the mercury weight thermometer would be theoretically perfect but for the fact that the temperature range available is somewhat restricted, and that the absolute expansion of mercury is more or less uncertain. The extrapolation of the observations beyond 300° C. is attended with some uncertainty, and the differences of the formulæ proposed to represent the expansion of mercury, though inconsiderable at low temperatures, become important when extrapolated. The value of the boiling point of sulphur hitherto assumed as the basis of the platinum scale of temperature, namely, 444°·53 C., depends on the determination of the correction by the linear expansion method alone. It appeared desirable to corroborate this result by the weight thermometer method.

With this object, Mr. Eumorfopoulos undertook a series of observations with a very delicate gas thermometer of Jena glass, the bulb of which was fitted to serve also as a mercury weight thermometer. The results of the several independent series of observations agreed among themselves to less than a tenth of a degree at the boiling point of sulphur, but differed by about 2° C. in the absolute value of the boiling point according as the formula of Regnault or that of Chappuis was adopted for the expansion of mercury. The value, according to Regnault's formula, was 443°·6 C., but it was 445°·8 C. according to the formula of Chappuis. Arrangements have in the meantime been made for the re-determination of the absolute expansion of mercury at the Royal College of Science, and it is hoped that the results of this work, which will be applicable to the reduction of previous observations, such as those of Mr. Eumorfopoulos, will reduce materially the present uncertainty.

"The Spectrum of Scandium and its Relation to Solar Spectra." By Prof. A. **Fowler.** Communicated by Sir William Crookes, F.R.S.

The greater part of this investigation of the spectrum of scandium under different experimental conditions has been based on purified scandia, generously placed at the author's disposal by Sir William Crookes. The principal results are as follows:—

(1) The arc spectrum of scandium consists of two distinct sets of lines, which behave very differently in solar spectra. Each set includes both strong and faint lines.

(2) Lines belonging to one set correspond with the enhanced lines of other elements, notwithstanding that they appear strongly in the ordinary arc spectrum:—(*a*) these lines are very feeble or missing from the arc-flame spectrum, and are strengthened in passing to the arc, the arc in hydrogen, or the spark; (*b*) they occur as relatively strong lines in the Fraunhofer spectrum; (*c*) they are weakened in the sun-spot spectrum; (*d*) they occur as high-level lines in the chromosphere.

(3) The remaining lines show a great contrast when compared with the first group:—(*a*) they are relatively strong lines in the arc flame; (*b*) they are very feebly represented in the Fraunhofer spectrum; (*c*) the stronger lines are prominent in the sun-spot spectrum; (*d*) they have not been recorded in the spectrum of the chromosphere.

(4) The special development of the enhanced lines in the Fraunhofer spectrum, together with their presence in the upper chromosphere, indicates that the greater part of the scandium absorption in the solar spectrum originates at a higher level than that at which the greater part of the iron absorption is produced.

(5) The discussion of scandium lines indicates that while in the case of some elements solar identifications are to be based chiefly on arc lines, in others it is the enhanced lines which may be expected to show the most important coincidences.

(6) The flutings which occur in the arc and arc flame do not appear when the arc is passed in an atmosphere of hydrogen. As suggested by Thalén, they are probably due to oxide of scandium.

Tables are given which show the lines of the arc spectrum from 3930 to 6580, the positions of the oxide flutings, and comparisons of the principal lines of the two classes with the sun, sun-spots, and chromosphere.

EDINBURGH.

Royal Society, November 2.—Prof. A. Gray, vice-president, in the chair.—Temperature observations on Loch Garry: E. M. **Wedderburn.** The observations were made during the first seven months of 1908 by means of reversing mercury thermometers, and led to the following general results:—(1) the observations give a complete series for the time of year during which the lake is gaining heat, so that comparisons may be made between Loch Garry, of comparatively small size, and Loch Ness, of much larger size; (2) they show the apparently fortuitous manner in which freezing may take place in the larger temperate lakes; (3) they show how strong winds have the effect of producing currents at considerable depths; (4) they prove that the formation of the discontinuity temperature layer in a lake occurs whenever the surface layer begins to cool; (5) they establish the existence of a temperature seiche in small temperate lakes like Loch Garry, and show that

this temperature oscillation may exist even when the discontinuity is not pronounced. The attempts to measure the ordinary seiche in Loch Garry were not very successful, the seiches being irregular and difficult to measure. The periods indicated were 10·5–11·1 minutes for the uninodal and about 5·5 minutes for the binodal.—The discharge of water from circular weirs and orifices: G. H. **Gulliver.** The elliptic integral which gives the discharge was computed graphically, and the results compared with experiment. Curves were drawn showing the relation between the discharge and the head. The observational and theoretical curves were of the same form, and were practically straight for heads between the centre and top of the circular aperture. This suggests that a circular weir, if kept more than half full yet not completely drowned, might be usefully employed in gauging streams. With the orifice of 2½ inches diameter used in the experiments, the discharge in gallons per minute was given by the formula $11H-0{\cdot}8$, where H is the head in inches above the lowest point of the orifice.—Dissymmetrical separations in the Zeeman effect in tungsten and molybdenum: Dr. Robert **Jack.** The relative intensities of the components of a Zeeman triplet depend upon polarisation effects of the grating in relation to the polarised state of the light. The experiments showed that concurrently with the change in the intensities of triplets for different parts of the spectrum there is a change in the type of dissymmetry. As the middle component passes through its minimum value there is a change from the normal dissymmetry (middle component nearer the red side component) to the abnormal dissymmetry (middle component nearer the violet side component). The dissymmetry could not be entirely accounted for by the angular position between the lines of the grating and the planes of vibration of the components. Voigt's theory based on the presence of couplings between electrons of different vibration period seemed to explain the phenomena sufficiently.—A question in absorption spectroscopy: Dr. R. A. **Houstoun** and A. S. **Russell.** The question is as to the effect of mixing two coloured solutions upon the absorption spectrum of each. Observations by Melde, Bostwick, Krüss, and Formánek seemed to indicate a shift of the absorption bands; but Schuster pointed out that a shift of this nature would be observed if, instead of mixing, the one solution was placed behind the other. Any other change indicated by theory would be too small to be appreciable. The experiments described in this paper were made by a differential method, so that the effect with the solutions in line, but not mixed, could be immediately compared with the effect when they were mixed. The conclusion come to was that there is no evidence for the existence of an effect of the kind described by the experimenters named above.

PARIS.

Academy of Sciences, November 2.—M. Emile Picard in the chair.—Spectroscopic researches on the Morehouse comet, 1908*c*: H. **Deslandres** and A. **Bernard.** The observations were commenced on October 14, ten days after those of La Baume-Pluvinel. Owing to the abnormal proportion of the blue to the ultra-violet rays, this comet, which was by eye observations of the sixth magnitude, appeared photographically of a higher magnitude. No trace of the hydrocarbon bands usual with comets could be detected; a continuous spectrum appeared on all the plates from October 14 onwards, but its intensity is relatively less than in the Daniel comet of last year. A table is given showing the wave-lengths and intensities of the principal condensations of the nucleus. Two ultra-violet bands of the cyanogen group are present, together with some lines of unknown origin, previously observed in Daniel's comet.—The pumice of the volcanic *massif* of Mont-Dore: A. **Lacroix.**—The value of the invariant ρ for a class of algebraic surfaces: L. **Remy.**—The influence of pressure on the ionisation produced in gases by the X-rays. The saturation current: E. **Rothé.** A study of the influence of pressure on ionisation phenomena in general. From pressures of 0·1 to 0·5 atmosphere the intensity of the saturation current is proportional to the pressure. The precautions found necessary for the regular working of the Crookes's tube are detailed.—Compensation electrometers and electroscopes: M. **Hurmuzescu.** The apparatus described, and of which a diagram is given, is capable of measuring potentials down to 0·01 volt.—An apparatus for receiving radio-telegraphic time signals on board ship: C. **Tissot** and Félix **Pellin.** A thermoelectric detector is employed, capable of responding to waves of one determined wave-length only.—A new determination of the mechanical equivalent of heat: V. **Crémieu** and L. **Rispail.** The heat produced was measured at constant temperature in a Bunsen ice calorimeter, the recent determinations of M. Leduc on the densities of the ice and water being used. The mean value obtained for J was $4{\cdot}1851\times10^7$ ergs, with an experimental error of less than 1/1500.—The separation of tungstic acid and silica: Paul **Nicolardot.** The method is based on the volatilisation of the tungsten by heating the mixture of tungstic acid and silica to 440° C. in a current of partially dried air and chloroform vapour.—The determination of the atomic weight of the simple ponderable substance, pantogen: G. D. **Hinrichs.** A fundamental material, pantogen, of atomic weight 1/128, or 0·007813, is assumed, and a theory developed of the weight and geometrical form of the atoms of hydrogen, helium, nitrogen, oxygen, and fluorine.—The phosphides of zinc: Pierre **Jolibois.** Zinc and red phosphorus were heated to a red heat in a crucible until phosphorus vapours ceased to be evolved. The resulting phosphide was separated from the excess of zinc by three methods:—the volatilisation of the zinc in a vacuum at 600° C., the solution of the zinc in mercury, and the action of fuming nitric acid. The same phosphide is left by all three methods of separation, and its composition corresponds to the formula Zn_3P_2. This phosphide with dilute hydrochloric acid gives a very pure phosphoretted hydrogen. The preparation and properties of ZnP_2 are also described.—The hydrolysis of perchloride of iron; the influence of neutral salts: G. **Malfitano** and L. **Michel.** Solutions of ferric chloride to which potassium chloride has been added present the phenomena of the colloidal state more rapidly and to a greater degree than solutions of pure ferric chloride. Other chlorides (sodium, barium, ammonium, magnesium) behave in a similar manner.—Aloesol, a complex phenol prepared with the aid of certain aloes: E. **Léger.** The tetrachloro-derivative of a new phenol is obtained by the action of hydrochloric acid and potassium chlorate on Cape aloes.—The fixation of different derivatives of the same colouring matter, and an explanation of dyeing: L. **Pelet-Jolivet** and N. **Andersen.** The experiments cited confirm the theory of dyeing of Freundlich and Loser.—Glycocholic acid: Maurice **Piettre.** The method described is capable of giving a yield of 60 per cent. to 75 per cent. of the bile as glycocholic acid, and the product is not contaminated with taurocholic acid, an advantage over the usual methods of separation. The chemical and physical properties of the purified acid are given, together with the results of some experiments on the toxic power of sodium glycocholate.—The colloidal properties of starch and the unity of its constitution: Eugène **Fouard.**—The oïdium of the oak: Paul **Hariot.** This disease of the oak has become widely distributed in France during the last year, and the dry north-east winds appear to have contributed to the spreading. All the native trees may be attacked, but the American oak appears to be immune.—The discovery of coal in Madagascar by Captain Colcanap: Marcellin **Boule.** Layers of coal, of a thickness of 0·3 to 0·5 metre, have been discovered in the neighbourhood of Bénénitra.—Report of the wireless telegraphy committee of the Academy of Sciences: Bouquet **de la Grye.**

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 12.

ROYAL SOCIETY, at 4.30.—The Charges on Ions in Gases, and the Effect of Water Vapour on the Motion of Negative Ions: Prof. J. S. Townsend, F.R.S.—The Charges on Ions produced by Radium: C. E. Haselfoot.—The Occlusion of the Residual Gas and the Fluorescence of the Glass Walls of Crookes's Tubes: A. A. Campbell Swinton.—An Investigation on the Anatomical Structure and Relationships of the Labyrinth in the Reptile, the Bird and the Mammal: Dr. A. A. Gray.—The Natural Mechanism for Evoking the Chemical Secretion of the Stomach (Preliminary Communication): Dr. J. S. Edkins and Miss M. Tweedy.—Further

Observations on Welwitschia: Prof. H. H. W. Pearson.—On the Presence of Hæmo agglutinins, Hæmo-opsonins and Hæmo-lysins in the Blood obtained from Infectious and Non-Infectious Diseases in Man (Preliminary Report): L. S. Dudgeon.—Preliminary Note on the Occurrence of a New Variety of Trypanosomiasis on the Island of Zanzibar: A. Edington.

MATHEMATICAL SOCIETY, at 5.30 (*Annual General Meeting*).—On the Theory of Groups of Finite Order (Presidential Address): Prof. W. Burnside.—On the Dirichlet Series and Asymptotic Expansion of Integral Functions of Zero Order: J. E. Littlewood.—The Norm Curves on a Given Base: Prof. F. Morley.—Satellite Curves on a Plane Cubic: J. O'Sullivan.—On the Arithmetical Nature of the Coefficients in a Group of Linear Substitutions (Third Paper): Prof. W. Burnside.—On the Second Mean Value Theorem of Integral Calculus: Dr E. W. Hobson.—On the Representation of a Function by Means of a Series of Legendre's Functions: Dr. E. W. Hobson.—The Conformal Transformations of a Space of Four Dimensions and their Applications to Geometrical Optics: H. Bateman.—Periodic Properties of Partitions: D. M. Y. Sommerville.—The Solution of Integral Equations: Prof. A. C. Dixon. The Eliminant of Three Quantics in Two Independent Variables: A. L. Dixon.—A Note on the Continuity or Discontinuity of a Function defined by an Infinite Product: G. H. Hardy.—The Energy and Momentum of an Ellipsoidal Electron: F. B. Pidduck.—On q Integration: Rev. F. H. Jackson.—On q-Transformations of Power Series: Rev. F. H. Jackson.—The Complete Solution in Integers of the Eulerian Equation $X^4+Y^4=U^4+V^4$: Dr. T. Stuart.—An Asymptotic Formula for the Generalised Hypergeometric Series: T. J. I'A. Bromwich.

FRIDAY, NOVEMBER 13.

PHYSICAL SOCIETY, at 8.

MALACOLOGICAL SOCIETY, at 8.—Note on *Diplommatina strubelli*, Smith: E. A. Smith.—The Radulæ of British Helicids, Part ii: Rev. E. W. Bowell. New Marine Mollusca from New Caledonia, &c.: G. B. Sowerby.—New Species of Macrochlamys and Monocondylæa from Siam: H. B. Preston.—A New Species of Oliva: F. G. Bridgman.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Huxley Memorial Lecture: The European Population of the United States: Prof. W. Z. Ripley.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Short-Period Variable W Ursæ Majoris: J. M. Baldwin. On the Inclination of the Planes of some Spiral Nebulæ to the Galaxy: H. Knox Shaw.—Observations of Jupiter during the Apparition of 1907-8: Rev. T. E. R. Phillips.—Calendar Dates in the Aramaic Papyri from Assuan: J. K. Fotheringham. On the Photographs of Comet 1908 *c* Morehouse: E. E. Barnard.—Observations of Minor Planets from Photographs taken with the 30-inch Reflector, 1907: Royal Observatory, Greenwich.—The Total Solar Eclipse of 1911, April 28: A. M. W. Downing.—The Comet of 1556; its Possible Breaking-up by an Unknown Planet into Three Parts, seen in 1843, 1880, and 1882: Prof. George Forbes.—On the Old Observations of Jupiter's Satellites: Prof. R. A. Sampson.—An Improved Telescope Triple Object Glass: J. W. Gifford. Real Paths of Brilliant Meteors Observed in 1908: W. F. Denning.—(1) Photographs of Comet *c* 1908; (2) Note on the Telegraphic Determination of the Longitude Greenwich-Ascension-Cape, in the Year 1908; (3) Note on the Appearance of Saturn's Rings, 1908 October: Royal Observatory, Greenwich. Note on the Regnal Years in the Aramaic Papyri from Assuan: E. B. Knobel.—(1) Historical Data for the Secular Acceleration of the Moon: (2) Oppolzer's and Ginzel's Corrections to Hansen: J. K. Fotheringham.—*Probable Papers*: On the Absorption of Light in its Passage through Interstellar Space: (2) Note on the Number of Faint Stars with Large Proper Motions: Prof. H. H. Turner.—The Flagstaff Photographs of Mars in 1907: E. M. Antoniadi.—Illustrations of Recent Work on Solar Vortices: Prof. G. E. Hale.

MONDAY, NOVEMBER 16.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Some Aspects of the River Paraná, and its Watershed: an Economic Survey: W. S. Barclay.

TUESDAY, NOVEMBER 17.

ZOOLOGICAL SOCIETY, at 8.30.

ROYAL STATISTICAL SOCIETY, at 5.

MINERALOGICAL SOCIETY, at 8.—On a New Method for Studying the Optical Properties of Crystals: the late Dr. H. C. Sorby, F.R.S.—Note on the Spontaneous Crystallisation of Drops of Solutions in Spherulites: M. Jacques Chevalier.—On the Composition of the Chandakapur Meteoric Stone: H. E. Clarke and H. L. Bowman.—On Micas from North Wales and Connemara: Dr. A. Hutchinson and W. Campbell Smith.—On the Occurrence of a Rare Mineral, Carminite in Cornwall: Arthur Russell.—On Russian Universal Instruments and Methods: T. V. Barker.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: Glasgow Central Station Extension: D. A. Matheson.

WEDNESDAY, NOVEMBER 18.

ROYAL SOCIETY OF ARTS, at 8.—Inaugural Address by Sir William White, K.C.B., F.R.S.

GEOLOGICAL SOCIETY, at 8.—The Geological Interpretation of the Earth-Movements Associated with the Californian Earthquake of April 18, 1906: R. D. Oldham.—On some Intrusive Rocks in the Neighbourhood of Eskdale, Cumberland: A. R. Dwerryhouse.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—The Present Status of Micrometry: Dr. Marshall D. Ewell.—Note on a New Growing Cell for Critical Observation under the Highest Powers: A. A. C. E. Merlin.—Studeria, a Remarkable New Genus of Alcyonarians: Prof. J. A. Thomson.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Twenty-fifth Anniversary of the German Meteorological Society held at Hamburg, September 28-30, 1908: Henry Harries.—Investigation of the Electrical State of the Upper Atmosphere made at the Howard Estate Observatory, Glossop: W. Makower, Margaret White and E. Marsden.—Balloon Observations made at Birdhill, Co. Limerick, during July and August, 1908: Capt. C. H. Ley.

THURSDAY, NOVEMBER 19.

ROYAL SOCIETY, at 4.30.—*Probable Papers*.—Memoir on the Theory of the Partitions of Numbers. Part IV.: On the Probability that the Successful Candidate at an Election by Ballot may Never at any Time have Fewer Votes than the One who is Unsuccessful; on a Generalisation of this Question; and on its Connection with other Questions of Partition, Permutation, and Combination: Major P. A. MacMahon, F.R.S.—The Propagation of Groups of Waves in Dispersive Media, with Application to Waves on Water produced by a Travelling Disturbance: T. H. Havelock.—On the Refraction and Dispersion of Krypton and Xenon and their Relation to those of Helium and Argon: C. Cuthbertson and M. Cuthbertson.—Note on Horizontal Receivers and Transmitters in Wireless Telegraphy: Prof. H. M. Macdonald, F.R.S. On Optical Dispersion Formulæ: R. C. Maclaurin.—(1) On the Accumulation of Helium in Geological Time: (2) On Helium in Saline Minerals and its Probable Connection with Potassium: Hon. R. J. Strutt, F.R.S.—Note on the Effect of Hydrogen on the Discharge of Negative Electricity from Hot Platinum: Prof. H. A. Wilson, F.R.S.—On Measurement of Rotatory Dispersive Power in the Visible and Ultra-violet Regions of the Spectrum: Dr. T. Martin Lowry.

CHEMICAL SOCIETY, at 8.30.

LINNEAN SOCIETY, at 8.—On a New Species, Symphyla, from the Himalayas: Prof. A. D. Imms.—The Freshwater Crustacea of Tasmania, with Remarks on their Geographical Distribution: Geoffrey Smith.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Inaugural Address by the President: Mr. W. M. Mordey.

FRIDAY, NOVEMBER 20.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Resistance of Materials to Impact: Dr. T. E. Stanton and L. Bairstow.—Different Methods of Impact Testing on Notched Bars: F. W. Harbord.

CONTENTS.

THURSDAY, NOVEMBER 19, 1908.

GEOLOGY OF CHINA.

Research in China. Vol. ii. Systematic Geology. By Bailey Willis. Pp. v+133+v. (Washington: Carnegie Institution, 1907.)

IT is difficult to be quite sure for what class of reader this work is intended. The main facts of interest have already appeared in the previous volume, but in this they are discussed from "the point of view of systematic continental history." In the present state of knowledge this might seem rather a hopeless undertaking, and the result does not dispel our misgivings; much of the explanatory matter is elementary, and much is merely speculative.

The reader's confidence in the author is somewhat rudely shaken at an early stage, as, for instance, at the close of chapter ii., where, on p. 34, it is first stated that "there is room to question what features existed in Central Asia during the Sinian period"; six lines further on, owing to the fact that the Sinian strata consist of limestone, this becomes "it is a fair inference that practically all Asia draining to the Cambro-Ordovician Sea was low and featureless." The next paragraph, however, begins, "The fact that Asia at the opening of the Paleozoic era was a featureless continent has important bearings." After this bold identification of fact with inference, it becomes necessary to inquire into the credentials of other so-called facts. One of the most interesting results recorded is the discovery of a glacial till in ancient rocks, said to be Cambrian. Convincing proof is given of the glacial character of this deposit; its age does not seem to be so clearly established. In the present volume we read,

"The tillite (*sic*) passes into a greenish shale . . . including characteristic pebbles. . . . This shale conglomerate . . . grades into the overlying limestone, the basal layer of a great thickness of Sinian."

But if we turn to vol. i., Blackwelder informs us that

"The Nan-t'ou formation [of which the till is the uppermost member] is limited above by an uneven surface, upon which lies a sheet of conglomerate. The matrix of the conglomerate is a greenish argillaceous limestone and the pebbles are like those in the underlying tillite. The two formations are therefore related by a basal conglomerate, which the till was well calculated to furnish. . . ."

This statement is sufficiently clear, and is accentuated by the two diagrams representing the succession of strata given on pp. 264 and 268, in each of which an undulating line is drawn between the conglomerate and the till. What, then, is in fact the relation of the till to the conglomerate? Do they pass into each other (Willis), or are they separated by an uneven line (Blackwelder)? But, again, is even the asserted age of the conglomerate a fact, or is it an inference? Turning once more to vol. i., we find on p. 269 that the till

"lies at the base of the Cambro-Ordovician limestone, from which we obtained Lower and Middle Cambrian fossils within less than 100 miles . . . of Nan-t'ou. Hence it is highly probable that these glacial beds on the Yang-tzi are of early Cambrian age."

Though the fossils were found only a hundred miles away, we should still have been glad of additional evidence to show that the beds at Nan-t'ou were on one or other of the horizons they indicate.

It is of interest to note in passing that since the Sinian formation is equivalent to the Cambrian and Ordovician, it almost precisely corresponds to the Cambrian as defined by Sedgwick.

The summit of this formation is said to be on the horizon of the Trenton or Middle Ordovician; above this "it passes by transition into shales which are probably of Silurian or Devonian age." The suggested *passage by transition* of Middle Ordovician into either Silurian or Devonian shales leads to the suspicion that the author uses this term in some esoteric sense.

The treatment of the Angara and Gondwána beds is one of the most unsatisfactory chapters in the volume; both series are included under the head of Permo-Triassic strata, while so far as existing observations go, the Gondwána beds begin with the Lower or Middle Carboniferous,[1] while the most trustworthy evidence we possess points to a Jurassic age for the Angara. There is an inexactitude also in defining the limits of the Angara beds; they are not confined to the northern region indicated by the author, but extend to Afghanistan and through Turkestan, as Musketow has already pointed out.

Students of the geology of India will be surprised to learn that "no distinctly sedimentary pre-Cambrian rocks are known there," *i.e.* in the peninsula (p. 23), and those who have given attention to ripple marks will scarcely admit that they are to be taken offhand as evidence of "waves" in the common sense of this term (p. 38).

The structural trend-lines of Asia seem to be drawn for the most part after the maps of von Richthofen, Suess, Neumayr, and Futterer; it is pleasing to find that the generalisations of these great masters have been almost entirely confirmed by recent investigators. But we see no evidence for the postulated "Isle of Tibet." A region of which the geology is almost unknown naturally offers great temptations to the theorist.

There is some internal evidence of hasty writing, such as inaccuracies in translation conveying a rather different sense from that of the original; as an example we may cite the last sentence of the first paragraph (p. 69) from Suess:—

"The great height of the ranges is accompanied, however, by a relatively even more striking altitude of the valleys, a circumstance which diminishes the differences of level in the interior of the mountainous regions, but the observer is even thus below the limit of eternal snow."

This is rendered from the French, which runs:—

"L'altitude plus forte des chaînes a pour contrepartie une hauteur plus grande des fonds de vallées, ce qui atténue les différences de niveau à l'intérieur

1 Neumayr and Waagen concluded in favour of an Upper Carboniferous age long ago, and Hayden has since shown that they must lie even lower.

de la région montagneuse, mais l'observeur ne s'en trouve que plus rapproché de la limite des neiges éternelles."

The French is a correct translation of the German.

The pith of this volume might have been summed up in a single chapter without losing any important contribution to science, and the space so saved might have been devoted to a much-needed bibliography of the subject. The author would not then have completely overlooked the work of the French explorers in Yün-nan. The artistic excellence of the numerous maps by which the volume is illustrated deserves unqualified praise.

FLOWERS AND WHAT THEY TEACH.

Types of Floral Mechanism. A Selection of Diagrams and Descriptions of Common Flowers. Arranged as an Introduction to the Study of Angiosperms. By Dr. A. H. Church, Part i., Types i.–xii. (January to April). Pp. vii+211; with 52 full-page plates (39 coloured) of floral structure, and 79 text-figures. (Oxford: Clarendon Press, 1908.) Price 21*s.* net.

THE title conveys a very imperfect idea of the nature of this work, which stands apart from all others that have been issued as introductions to the study of botany. The method of teaching botany by a careful investigation of selected types is, indeed, well known and much employed; but it has never been carried out, in English works at least, with any approach to the thoroughness of study of the types in themselves and in their relations to their environment and to their allies that we find here.

The author in a preface informs us that the admirable illustrations were originally prepared for class purposes, limited to a hundred types, of which twelve "Early Spring Types" are included in the present volume, and the arrangement and general scheme are designed to represent the working method applicable to the subject.

"No methods are indicated, nor have any been employed in making preparations which are beyond the reach of the 'elementary student'; and at the same time a general 'elementary' acquaintance with the subject on the part of the reader has been assumed. Since it is necessary to draw the line somewhere . . . and the present work is admittedly of only a general and elementary character, histological details are omitted."

The twelve types treated of are, successively, *Helleborus niger, Galanthus nivalis, Jasminum nudiflorum, Crocus vernus, Richardia africana, Daphne Mezereum, Viola odorata, Narcissus Pseudo-narcissus, Erica carnea, Ribes sanguineum, Cydonia japonica,* and *Vinca major.*

In the study of such a series, it is evident that there can be no close connection traced by an "elementary student" between so different types. Thus each becomes the subject of a separate monograph. That on *Viola odorata* may be taken as an example. A brief general notice of its appearance, habitats, tendency to vary, and production of cleistogamic flowers is accompanied by footnotes with references to descriptions and figures by Dioscorides, Brunfels, Gerarde, and other early botanists, and to its names and cultivation in England. Then follow a detailed description of the inflorescence and flower, and a brief notice of the effects of cultivation on the flower. The floral diagram and phyllotaxis are fully discussed and illustrated, as are also the development of the floral members and the "special mechanism" of the flower for securing the reproduction of the species, including the relations with various bees. The cleistogamic flowers and the possible origin of this type of flower are then treated of.

The various floral "monstrosities" are enumerated, and are "referred to failures in the adjustment of certain features of the floral construction or mechanism." The development and structure of the capsules, their mode of opening, and the structure of the seeds conclude the discussion under *V. odorata.* Then follows a "Comparison of Allied Forms," under which six and a half pages are devoted to *Viola tricolor,* chiefly var. *arvensis,* and five pages to *V. altaica,* or "the garden pansy." For each of these a detailed comparison of the structure and mechanism of the several parts brings into view their resemblances and differences, and their relations with their environment. Although reference is made to the "very variable" *V. tricolor,* there is little stress laid on the extent of the tendency to vary, and the opinion is expressed, even with regard to the relations between *V. tricolor, V. lutea,* and allied alpine forms, that "no sharp line of demarcation either exists or need be drawn between 'specific forms' which only exist as useful conventions." While there is a risk of attaching too high a value to the many forms that have been distinguished and named by critical botanists in the genus Viola, as in a good many other genera, it may be questioned whether the author might not have usefully directed the attention of students to the nature and degrees of constancy of the forms so freely met with in the Linnean *V. tricolor.*

The study of the types selected is employed by Dr. Church as a basis for certain "Theoretical Conclusions" with regard to the origin and development of the genus Viola. The hypothesis is expressed that *V. odorata* is a "highly specialised representative of a shrubby, or even arboreal, plant-phylum," with "panicles of regular flowers, which had already passed from an asymmetrical vegetative type of construction to a symmetrical pentamerous condition." From this a later evolution led to structural eccentricity of two phases, and to adaptations of the floral mechanism for visits of certain insects. These conclusions find support from a study of the genera associated in the family Violaceæ, Viola standing out "as the crowning genus of the entire group; the type, that is to say, in which the various modifications of the original construction are present in the greatest number, and combined to make a most efficient form of floral mechanism." The relations of the forms included under the family to types in other families are discussed, and the steps are summarised that led to the definition of the Violaceæ as a family.

The other eleven types are treated with almost similar fulness, and numerous interesting problems are brought into notice. The arrangements of the floral members (phyllotaxis) in each type receive especial attention, as might be expected from an adept in this subject.

Dr. Church has produced a valuable contribution to botanical literature, excellent alike in the text and in the illustrations, and the execution is worthy of the Clarendon Press. If the remaining eighty-eight types are worked out in the same manner as their forerunners, the whole will form one of the most valuable introductions to the study of angiosperms in any language, but there is reason to doubt whether its necessary size and cost, and the thoroughness of the treatment, may not put it out of reach of most "elementary" students of botany. Its value will be more appreciated by teachers and by advanced students; few botanists can fail to benefit from its pages, and no botanical school can afford to neglect so valuable and suggestive a storehouse of information. There is the more reason to regret that it is on the heavy, highly glazed paper so trying to many eyes and of very doubtful durability.

COTTON WEAVING.

The Cotton Weaver's Handbook. By H. B. Heylin. Pp. x+326. (London: Charles Griffin and Co., Ltd., 1908.) Price 6*s.* net.

DURING the last twenty-five years many excellent books dealing with textile subjects have been published in Germany, America, and England, but in none of them has cotton weaving been treated as Mr. Heylin treats it. His book contains 462 pages, of which 112 are blank paper, 12 sheets are blank design paper, and 326 pages are of printed matter, the latter being divided as follows:—8 pages are allotted to the index, 30 to a reprint of cotton-weaving examination questions set by the City and Guilds of London Institute, and 36 pages to pictures of textile machinery. On the remaining 252 pages there are upwards of 350 figures, but with the exception of those relating to designs, drafts, and lifting plans, the illustrations are poor. Most of them consist of pictures of machinery and appliances which are of small value to the student, and when, as in this case, they are mainly without reference letters, and inadequately described, they do little more than add to the size of the book. The following may be taken as examples of the majority of these illustrations. Fig. 350 is a picture of a smallware loom, and the descriptive matter consists of "There is a separate shuttle for each tape woven." Fig. 357 has letters added to special mechanism, but these are not referred to. Figs. 273, 274, and 275 are perspective, edge, and plan views of ladder tape, and the only description given is that "ladder tape used for Venetian blinds is a good example of what may be done by the four-ply system of weaving."

In the text there is ample evidence of haste. Statements are repeated again and again, as on pp. 30, 32, and 34, where we are told that the scope for producing a variety of weave effects is in proportion to the number of threads in the repeat of a design. Again, on pp. 16, 18, and 33, similar repetitions are found concerning broken drafts. That mistakes are very numerous will be seen from the following, which are selected, almost at random, from a long list. On p. 84 it is stated that the ordinary picking motion is "put out of action whilst the wire is inserted to form the warp pile." In these looms the shuttle and the wire are passed through the warp together. The twist tester figured on p. 190 is said to "take out the twist at both ends of the thread simultaneously," whereas it can only untwist from one end. On p. 124, Fig. 294 should read Fig. 296. On the last line of p. 170, /120 should read 4/120, and on p. 225 "the slacker will be the top speed" should read "the slacker will be the top shed." On p. 214 the calculation for determining the point of connection between the back heald cords and the tappet treadle is wrong, and resolves itself into a calculation to determine the required lift of a tappet for operating the back heald shaft. On p. 221 a swing pinion is said to be compounded with a wheel *D*, and also to gear with the wheel *D*. Three calculations are given on p. 245; one is without answer, and both the others lack some of the cancelled figures.

The chapter on weaves is the best in the book, but since this branch of the subject has been more exhaustively treated by German, American, and British writers than any other, it would perhaps be unreasonable to expect Mr. Heylin to say much that is new concerning them. With regard to the heading of this chapter, it is stated on p. 6 that the term "weave is sometimes miscalled design"; nevertheless, the latter term is used throughout the book. The chapters on the power loom and its accessories, and on preparing yarn for the loom, are quite inadequate. Frequent reference is made for details to the frontispiece, which is an unlettered picture of a power loom, and, therefore, affords no means of identifying the parts. To a reader who is familiar with the loom such descriptions as are given are useless, and to others they will be unintelligible. The "Costing of Cloth" precedes the "Systems of Naming Yarns," and prices are given in shillings, pence and farthings, instead of in pence and decimals of pence; also, where yarns are weighed, pennyweights and grains are used instead of grains only. Several pages are occupied with rules and examples for determining the counts of folded yarns, but in no case is the basis of a rule given; further, the problems do not amount to more than the addition, or the subtraction, of fractions, as, $\frac{1}{20}+\frac{1}{30}+\frac{1}{60}=\frac{1}{10}$, and $\frac{1}{12}-\frac{1}{20}=\frac{1}{30}$. An undated market report with official quotations for cotton and yarn occupies five pages.

By a thorough revision, and by filling in the blank pages and deleting the examination questions, the subjects named in the contents might be adequately dealt with, but in its present form this book contains so little that is new, and so much that is inexact or untrue, that it is difficult to say for whom it is suited.

ELECTRICAL TESTING.

Laboratory and Factory Tests in Electrical Engineering. By George F. Sever and Fitzhugh Townsend. Second edition, revised and enlarged. Pp. xii+269. (London: A. Constable and Co., Ltd.; New York: D. van Nostrand Co., 1908.) Price 10s. 6d. net.

IT is almost unavoidable that a book on laboratory practice, written by men whose duty it is to plan and superintend the work done by students, must savour somewhat of the instruction sheets which at universities are supplied to the laboratory classes. It is equally unavoidable that such instruction cannot be given in perfectly general terms, but must be adapted more or less to the syllabus in use at each particular university, and to the plant provided for the laboratory. Thus a work on laboratory tests may be exceedingly useful to students working at the particular laboratory to which it refers, but whether students at other institutions will be able to derive much benefit from it is doubtful. The advanced student and the scientific engineer, who is already in practice, will probably also be able to derive some advantage from the book under review, but he would reap the same advantage with less mental labour from any elementary text-book on electrical engineering. The words "factory tests" in the title must be taken to mean that the tests used in a particular laboratory may more or less also be used in a factory. This is, of course, true of all work carried out in a modern well-equipped laboratory, and, therefore, not a distinctive feature of the methods described in the present work.

It is certainly difficult to compress into 260 pages the whole subject of electrical testing, and want of space may be the reason why the authors have treated certain subjects in a very brief one is almost tempted to say sketchy—manner, but I think they have not been judicious in the matter of curtailment, inasmuch as they have shortened or omitted altogether the exposition of general principles. On the other hand, they have unduly expanded the mere routine of testing. As an example of sketchy treatment of fundamental matters, take the Heyland diagram on p. 172 of the induction motor, which is given on the assumption that the motor has neither ohmic nor iron losses, and the various vectors are indiscriminately referred to as representing magnetomotive forces, currents, flux, or electromotive forces, without a word of explanation. That such treatment of a difficult subject must have seemed to the authors themselves somewhat unsatisfactory may be gathered from the following sentence, which occurs on p. 173:

"This diagram has been so fully discussed in the literature of the induction motor that it is not thought necessary to reproduce the proof of it here."

Just so. The authors assume that the fundamental principles are known, and content themselves with giving mere rules for testing.

The book is divided into three parts. The first deals with preliminary measurements and with tests of continuous-current machines. In the second part we come to alternating-current machines and transformers, and then follows the third part, which bears the title "Electrical Measurements." This title is rather misleading, for here we find such subjects as the determination of the leakage coefficient of a dynamo, the Hopkinson method of testing for permeability, Ewing's hysteresis tester, Ewing's magnetic bridge, the plotting of the hysteretic loop—all subjects which one would rather call magnetic, not electrical, tests. However, a title which only fits part of the contents is not a serious matter, but that some electrical tests are treated in a very superficial manner is a decided drawback. Thus the Wheatstone bridge, which logically ought to have found a place in the first part, is dismissed in two pages of letterpress and a very imperfect diagram, whilst no mention is made of Varley's bridge or Thomson's double bridge. The potentiometer fares even worse. The diagram on p. 250 is crude and incomplete, and it is no help to the reader to be told on p. 251 that "for commercial use the potentiometer is usually arranged in some compact and convenient form." It is precisely the instrument as practically used with all its refinements that the reader expects to find in a book on laboratory and factory testing.

The third part also deals with tests on batteries and photometric work. Since both these subjects together occupy barely nine pages, it is clear that the treatment can only be very superficial. One feature of the book which strikes the reader as peculiar is that the authors omit in most cases to mention the origin of the methods they describe. Thus, Scott's name is not mentioned in connection with the change from three- to two-phase circuits, nor is Heyland's name mentioned when describing his diagram. Quite apart from the consideration that it is only fair to give credit where it is due, the suppression of such references is inconvenient to the reader. Certain discoveries, inventions, methods, or tests are known under the names of the men who first published them, and are usually identified in this manner. By omitting such means of identification, the young student loses touch with the subject he is supposed to acquire.

GISBERT KAPP.

SCHOOL ALGEBRAS.

(1) *Elementary Algebra—A School Course.* By W. D. Eggar. Pp. viii+324+28. (London: E. Arnold, n.d.) Price 3s. 6d.

(2) *A New Algebra.* By S. Barnard and J. M. Child. Vol. i., containing Parts i., ii., and iii., with Answers. Pp. x+371. (London: Macmillan and Co., Ltd., 1908.) Price 2s. 6d.

(3) *Algebra for Secondary Schools.* By Dr. Charles Davison. Pp. viii+623. (Cambridge: University Press, 1908.) Price 6s.

(4) *The Eton Algebra.* Part i. By P. Scoones and L. Todd. Pp. xxv+184. (London: Macmillan and Co., Ltd., 1908.) Price 2s. 6d.

(1) THIS book covers most of the ground required for boys who are not specialising in mathematics, with exercises in logarithms and a short chapter on trigonometric ratios. There are tables of

these functions and of square roots at the end of the book. There is an excellent collection of examples, many of which are of a practical type, and, therefore, in themselves more interesting than the old-fashioned academic questions. The proofs of formulæ and methods are in some cases somewhat concise, and would need amplification by the teacher. In particular, the proof of the binomial theorem and the explanation of the method of finding square roots are of this character. In some cases the author adopts the heuristic method, and requires the student to derive formulæ for himself, as, for instance, in finding the factors of $x^3 \pm y^3$ and $x^3+y^3+z^3-3xyz$, and in finding the meaning of fractional indices and the values of logarithms.

We should like to see less formal methods of finding the H.C.F. of two algebraic expressions, based on the fact that $R=aA-bB$ contains the common factors of A and B, as in many cases R can be factorised and the common factors detected with much less trouble and with a more direct appeal to common sense than by the formal method. The chapter on factors is very fully and carefully done, and this method would be a natural sequel.

The use of graphs is well exemplified and illustrated by a good number of examples. The chapters on ratio, proportion, and variation are good, especially in the selection of interesting practical examples.

(2) Messrs. Barnard and Child have made a brave attempt to give a logical development of algebra in a form suitable for school work. They explain the meaning of the laws of association, commutation, and distribution as applied to addition, subtraction, multiplication and division, and lead up to the solution of what are to a beginner quite difficult problems.

Negative numbers are not considered until part ii. (p. 149), and are there explained by extending the scale of natural numbers backwards. In this part some of the difficulties would seem to be too delicate for the comprehension of a beginner, as, for example, the distinction between $2+(-3)$ and $(-3)+2$. Every teacher must, of course, use his judgment as to how far to press such niceties. The explanations are carefully given throughout, and the collection of examples is excellent. The method of factors is applied to finding the H.C.F. and L.C.M. of a set of expressions; in fact, one special and excellent feature of the book is its early introduction to factorisation. As soon as a boy can factorise with facility, the expressions have a form and interest to him which they did not possess before. Fractions are introduced in part iii., and theorems on equal fractions (the authors avoid the use of the term "ratio") are given in chapter xx. Graphs are introduced in chapter xxiii., and illustrated by useful examples. The book ends with quadratic equations and problems leading to them, followed by a useful series of test papers. We look forward with interest to the appearance of the second volume.

(3) This is a book on the model of Todhunter, with the re-adjustments and improvements in methods of proof which modern requirements demand. Proofs of index laws and of the binomial and exponential theorems are given for all commensurable numbers, and are assumed, perhaps, however, somewhat too silently, to hold for incommensurables also, the author evidently considering it wise to postpone a rigorous treatment of incommensurables. Indeterminate equations of the first degree are introduced early, and clearly illustrated by well-drawn graphs. There are good chapters on permutations and combinations, and on the simpler tests of convergency and divergency of series, and the chapter on miscellaneous graphs forms a useful introduction to curve-tracing. Continued fractions and probability are not treated. The book is excellently printed, and there are a good number of examples attached to the various chapters, but rather a scanty supply of miscellaneous examples (100) at the end of the book. This could be remedied in a subsequent edition.

(4) This consists of a collection of examples up to quadratic equations, prefaced by a set of specimen examples worked out, to secure uniformity of method, and concluding with miscellaneous examples arranged in short sets, and graduated in difficulty, so as to test a boy's knowledge at various stages of progress. There is an extensive collection of graphs, each of which is accompanied by useful instructions as to scale. No bookwork is given, as it is considered that, in the early stages of algebra, all explanation must be left to the teacher.

OUR BOOK SHELF.

Agriculture for Southern Schools. By J. F. Duggar. Pp. xi+362. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.) Price 4*s.* 6*d.*

THIS little book has been written, the author tells us, as an elementary text-book on agriculture that shall differ from others in having a definite and limited field—the southern States of the United States. While the principles underlying the subject are universal, their applications vary much in different localities, and by confining attention to a particular area it becomes possible to present the subject in the concrete way essential for beginners. The crops, soil conditions, and general facts of cultivation are all within the experience of the scholar or his farmer friends, and he is not likely to be troubled with that *bête noir* of the agricultural teacher—the principle that is perfectly sound in itself, but not economical, and therefore not applicable, in the particular district.

A perusal of the book shows that the author has succeeded in his somewhat difficult task. The essential principles are well brought out, and the illustrations are to the point. The opening chapters deal with the structure of the flower and seed-formation: peach, cotton, tobacco, and others being chosen as examples. The conditions necessary for germination and plant growth are then discussed, and the author next passes on to the highly important problem of adapting the crop to the soil. So much money has been lost in the past through planting crops unsuited to the soil that the author does well to direct attention to this matter; he points out, for instance, that sandy soils are best cropped with early vegetables, peaches, cotton, pea-nuts, water-melons, &c., while clay soils are better for hay crops, apples, &c. A few chapters are then devoted to manures, and

afterwards the special crops of the south are described. Succeeding chapters deal with plant diseases and insects; these, however, are written by specialists, as one man could not hope to write a useful book which would cover the whole range of the subject. Altogether the book appears to be admirably suited to the purpose for which it is intended, and it can be cordially recommended as a clear statement of the principles of the subject. E. J. R.

Vitality, Fasting, and Nutrition. By Hereward Carrington. With an introduction by Dr. A. Rabagliati. Pp. xl+648. (London: Rebman, Ltd., n.d.) Price 21s. net.

THE use of food of different kinds in disease, and the need of prohibition of food either in part or *in toto*, is a necessary part of the knowledge of every medical practitioner. The author of the above work seeks to magnify the importance of fasting over prolonged periods as the sole means of curing all the ills of human flesh. Some years ago another American writer wrote a book entitled the "No Breakfast Cure," in which the omission of this very pleasant meal was lauded as the universal panacea for all illness. Mr. Carrington has, however, "gone one better," and advises the discontinuance of all meals. His book is a strange medley, and hardly merits serious consideration in a scientific journal. Among its many assertions which are unsupported throughout by any experimental evidence are the following:—All medical science is wrong *ab initio*; diseases are nature's mode of cure; the taking of the impurities called foods is the source of all evil; the germ theory of disease is a myth; the law of conservation of energy is a fiction; food is not a source of energy or strength, but of weakness; the energy of the body is derived from an internal source, a kind of vital spirit in one's interior which can only be cleansed and rendered pure by the agency of starvation.

Happily for the sake of the too easily gulled public, he relates some cases illustrative of his method of cure. The perusal of these will be quite sufficient to prevent his therapeutic methods from obtaining a wide vogue. Some of these describe the ordinary symptoms of starvation somewhat graphically, but death when it occurred as the inevitable result is attributed to something else. Photographs are given of one patient reduced to the condition of a skeleton, but purified from the dross of food with the vital flame burning without hindrance. As a proof of this patient's vigour after a fast of forty-one days, the author naïvely remarks: "I helped him to undress and dress, though he could easily have done this himself."

The book is only remarkable as an instance of the lengths to which a fad can be carried.

W. D. H.

Die Cestoden der Vögel. By Dr. O. Fuhrmann. Zool. Jahrb., Suppl. 10, part i. Pp. 1–232. (Jena: Gustav Fischer, 1908.)

IN no group of vertebrates are cestode worms so numerous and of such varied types as among birds, and as these have hitherto been but little studied, Dr. Fuhrmann has for the last eleven years devoted a large portion of his time to their investigation, directing special attention to the tæniid, or tapeworm, group. The result is the present memoir, which bears full witness to the arduous nature of the author's labours. No fewer than sixty-four distinct generic types (many of them with numerous species) of these parasites are recognised as infesting birds, and the author has taken special pains to ascertain so far as possible the particular groups of birds to which these various genera respectively devote their attentions. This renders the work of value and interest to the ornithologist as well as to the students of parasitology, since the results have a distinct bearing on the mutual relations of different bird-groups. He shows, for instance, that the plover group (Limicolæ) has no parasites common to the gulls (Gaviæ), which may tend to show that these groups are less intimately related than is generally considered to be the case, although, before coming to a definite conclusion, the difference in their habitats must be borne in mind. Similarly, it is found that the parasitic worms of the diurnal birds of prey (Accipitres) are totally distinct from those of the owls (Striges), despite the fact that the food of many members of the two groups is identical. In this case we have confirmation of the modern view as to the wide sundering of the Accipitres and the Striges. To follow the author further is, within the limitations of our space, impossible, and we may therefore conclude by commending his work to the best attention of both ornithologists and helminthologists. R. L.

Thoughts on Natural Philosophy, with a New Reading of Newton's First Law. By A. Biddlecombe. Pp. 24. (London: Whittaker and Co., n.d.)

MANY and various are the subjects that may be included under the term "natural philosophy." The author, in a brochure of the modest length of twenty-four pages, refers to all the recent physical discoveries, over which he is enthusiastic. Radium and the theory of atomic disintegration, he says, "enabled him to jump to the apprehension of the speed theory of material combination which has formed the germ from which this sketch of a true natural philosophy has developed."

His main point seems to be that energy (or natural motion)—and the æther is considered to be material—is the original thing, and that rest is a secondary effect. He thus arrives—by "natural philosophy," shall we say?—at a point not very distant from the modern doctrine of energy, although he himself appears to consider that this point of view is unorthodox. The "speed theory" is best described in the author's own words:

"This is the great truth, and appears to be the key to the Riddle of the Universe—viz., that the speed[1] and weight of granules, corpuscles, atoms, and molecules, and the peculiarities of movement resulting from that speed and weight, give to substances their distinguishing characteristics, and account for all natural phenomena."

With this as a possible point of view, none, probably, will be disposed to quarrel. Though it may be new to the philosopher, it will sound not altogether unfamiliar to the man of science.

The Ruskin Nature Reader. Being a Collection of Literary Extracts to Accompany a Course of Nature Study. Selected and edited by G. R. Bennett. Pp. ix+236. (London: J. M. Dent and Co., n.d.) Price 1s. 9*d*.

THE judicious selection of literary extracts which Mr. Bennett has made shows convincingly what a strong appeal to our great writers natural objects and phenomena have always made. Though called after him, the reading-book is by no means confined to excerpts from Ruskin's work; indeed, there are only five such extracts among forty-four. Gilbert White, Tyndall, Izaak Walton, Darwin, and Richard Jefferies are among the writers drawn upon. If the book sends boys and girls out to observe for themselves, as Mr. Bennett hopes it will, it will have served a really useful purpose.

[1] Speed and movement may take many forms.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature.

An Electromagnetic Problem.

In the application of general principles to special cases it is sometimes found that the result is a seeming paradox, which is not always easy to remove. Such problems, although involving no new principle, are nevertheless of considerable interest, and after attaining their satisfactory solution we often realise that we did not before appreciate the full import of the general law.

The following question has been discussed with considerable interest among some of the writer's friends, and therefore it seemed not improbable that other physicists might be interested.

If two spheres of positive electricity are near together and are suddenly released, it is clear that their potential energy decreases as they separate and goes over into kinetic energy of motion. This kinetic energy is, of course, the energy of the magnetic field which results from the motion of the charges.

It seems possible, however, to arrange a system so that this magnetic field shall vanish because of symmetry, and the question then presents itself, Where is the energy? Suppose we have a sphere of positive electrification placed as the water is in a soap bubble, and capable of expanding under the mutual repulsion of its parts. The potential energy of the electricity certainly decreases as the sphere expands, and *if the electricity be considered continuous* there is certainly no chance for a magnetic field, as is easily seen from consideration of symmetry. If the sphere be allowed to expand, where does the energy go? The obvious answer is that the electricity is not continuous, but exists as discrete particles, *i.e.* as electrons; but if we try to escape the difficulty in this way, it is equivalent to admitting that the electrical laws, together with the conservation of energy, *require in themselves* the discrete structure of electricity. If, on the other hand, we say that the electricity is associated with matter, *i.e.* with ponderable mass, and the energy appears as ordinary mechanical energy of motion, then we are admitting that the electrical and energy laws *require the association of electricity with matter.*

There seem to be no other solutions to the problem than those above given, and if we admit either of them we reach a conclusion which certainly is striking when we consider that we have only used the general laws of electricity and energy.

The writer does not state the above as a fundamental paradox, but only as an interesting problem.

D. F. Comstock.

Institute of Technology, Boston, Mass., November 3.

The Progress of Aviation.

I have read with great interest the article on the above subject by Prof. Bryan in Nature of October 29.

May I be permitted to direct especial attention to the necessity for finding the displacement of the centre of pressure on all kinds of surfaces and at all angles therein referred to? The paper by Prof. Bryan and Mr. Williams on the subject of longitudinal stability, and Captain Ferber's article in the *Revue d'Artillerie* (November, 1905), both assume the truth of Joëssel's law. There is, however, every reason to suppose that there is a certain critical angle below which Joëssel's law ceases to be true, the displacement decreasing with the angle instead of increasing.[1]

Consequently, the numerical conclusions arrived at from the stability formulæ of Captain Ferber and Prof. Bryan may be very wide of the mark.

[1] Spratt-Moedebeck's "Pocket-book of Aëronautics" (1904); Wilbur Wright, Smithsonian Report, 1902, pp. 133–148 (*Journal of Western Society of Engineers*, December, 1901); Turnbull, *Physical Review*, vol. xxiv., No. 3, 1907.

I hope to experiment in this direction myself, but my time is very limited. There can be no doubt whatever that a thorough investigation as to the centre of pressure would be of the greatest practical use.

Herbert Chatley.

32 Britannia Road, Southsea, October 31.

I agree strongly with all that Mr. Chatley has said. It cannot be too emphatically pointed out that the object of our stability investigations was to show that the subject is capable of being treated mathematically, and that, *given the requisite experimental data,* the conditions of stability of any system of planes or surfaces can be calculated out in the form of numerical results. The cases in which this was done were intended merely as *examples* illustrative of the general method, and for this purpose Joëssel's law furnished the simplest assumption available at the time. It will be noticed, too, that arbitrary values were assumed for the moments of inertia of the systems. To draw inferences from the results of examples worked out with this object would be an unfortunate mistake.

It is to be regretted that want of time has prevented my attempting to work out any examples based on the Turnbull results, though the idea suggested itself when I saw the paper in the *Physical Review.* The theory of stability has thus been somewhat at a standstill. Those who, like Mr. Chatley and myself, would like to see that theory advanced are prevented from doing this by pressure of other duties, while those who have the necessary time and money have been mainly occupied of late in breaking records. Mr. Lanchester's theory of stability starts from so different a standpoint that it must be discussed at a future time.

G. H. Bryan.

Potato Black Scab.

The discovery this autumn of black scab in the potato crop in two localities in co. Down was the means, through the Irish Department of Agriculture, of supplying me with excellent material of diseased tubers for examination. I have kept the resting "spores" of the chytridian fungus *Chrysophlyctis endobiotica,* Schilb., causing the disease, under varied conditions of temperature, nourishment, moisture, and light, and have succeeded in causing the "spores" to germinate, especially by cultivation in potato juice. Each "spore" proves to be a zoosporangium, full of zoospores or zoogonidia, seen in active swarming motion before rupture of the sporangium. The zoospores, $1\cdot5$–$2\ \mu$ in diameter, escape through a slit-like opening in the wall of the sporangium 30–60 μ in diameter, and have the usual characters of a chytridian zoospore.

Since the publication of Schilbersky's short preliminary account in 1896 in the *Berichte der deutscher botanischen Gesellschaft,* and Potter's account of his discovery of the pest in Cheshire in 1902, we have learnt nothing of the life-history of this injurious fungus.

T. Johnson.

Royal College of Science, Dublin, November 17.

The Nature of γ Rays.

Experiments by Prof. Bragg and myself upon the secondary kathode radiation which proceeds from matter through which γ rays are allowed to pass, taken in conjunction with the similar result announced by Mr. Cooksey in Nature of April 2 (vol. lxxvii., p. 509) for X-rays, support the theory of the material nature of X and of γ rays originally advanced by Prof. Bragg.

The modification of the ether-pulse theory recently advanced by Prof. Thomson may possibly furnish a partial explanation of these effects, but in the light of some experiments which I have lately carried out upon the secondary γ rays, even this modification seems quite insufficient. A brief summary of these results is appended.

(1) The γ rays of Ra, and probably of Th, appear to consist of two distinct homogeneous bundles, the value of λ/Δ (where λ is the absorption coefficient and Δ the

density of the material) for the soft set being approximately four times that for the hard.

(2) For each set of rays the value of λ/Δ is constant, and practically independent of the nature of the absorbing material with which λ is measured, provided that in the case of the soft rays secondary effects be excluded.

(3) Secondary γ radiation appears on both sides of a plate which is penetrated by a stream of γ rays. There exists a marked lack of symmetry between the amount of secondary radiation which proceeds from the two sides.

(4) A lack of symmetry exists in the case of some substances between the quality of the radiation on the two sides.

(5) The last results seem very difficult to reconcile with a pulse theory. On the "material" theory propounded by Prof. Bragg no such difficulty arises.

(6) The secondary γ radiation appears to be derived from the primary by a process of scattering, this process generally involving a reduction in the subsequent penetrating power of the ray affected.

(7) There appears to be reason to believe that the distribution of the scattered radiation depends to some extent upon the hardness of the radiation which is scattered, also upon the nature of the material in which the scattering is produced. The softer radiation appears to be turned back to a somewhat greater extent than the hard. Materials of high atomic weight seem to be able to produce more complete scattering than those of lower atomic weight.

(8) The absorption of γ radiation which has already passed through a thickness of one substance by screens of a different substance may not in all cases give a true measure of the absorption of the original radiation which has been effected by the first screens.

J. P. V. MADSEN.

University of Adelaide, October 1.

[As there are few opportunities in Australia for an investigator to place his views quickly before a scientific public, we print the above letter, but with it the correspondence must cease. The subject is more suitable for discussion in special journals devoted to physics than in our columns.—ED. NATURE.]

The Origin of Spectra.

THE very interesting observation of the anomalous dispersion of luminous hydrogen in the neighbourhood of the $H\alpha$ line recorded by Messrs. R. Ladenburg and Stanislaw Loria in NATURE of November 5 (p. 7), and the known absence of the phenomena in ordinary hydrogen, show conclusively that *the spectrum lines of a substance are not free periods of the atoms in their normal state, but only of those systems produced somehow by the agency which gives rise to the spectra.*

The figure 1/50,000 as the number of electrons per atom of course means that in the gas under experiment only one atom in 50,000 was emitting the $H\alpha$ line at any one time. The very important remark is made that the anomalous dispersion in the neighbourhood of the other lines of the hydrogen series "is expected to be much smaller than that at the $H\alpha$ line." If this be so, it will show that at any given time different numbers of atoms are producing the different lines, that is to say, that the spectrum is not produced *in toto* by each atom. Each atom (or rather the system emitting the lines) may, for instance, only be emitting one line at a time. These results are the same as those I have deduced from Prof. R. W. Wood's work on the anomalous dispersion of sodium vapour. Sodium vapour shows anomalous dispersion in the neighbourhood of all the lines of the principal series, which "is very strong at D, feeble at the first pair of ultra-violet lines λ 3303, and almost imperceptible at λ 2852." It is also, Wood states, stronger at D_2 than at D_1. This shows that the number of atoms emitting D_2 at any time is greater than the number emitting D_1, and both these are much greater than the numbers emitting the higher members of the series. We note that there is no anomalous dispersion in the neighbourhood of the lines of the subordinate series of the sodium spectrum showing that heat alone does not produce those systems which vibrate with the periods of the subordinate series, which agrees with the facts that these series do not appear in the absorption spectrum of sodium vapour or in the Bunsen flame spectrum of sodium.

It thus seems probable that different series of lines in a spectrum are produced by entirely different vibrating systems, while any system possibly only emits one line at a time of its own particular series, depending upon the manner in which it has been struck. It is evident that the different vibrating systems obtained, and their relative proportions, may be expected to vary with the nature of the electrical discharge producing the spectra, and hence the variation of the spectra under different conditions. This may, perhaps, on the modern views, be regarded as the same idea put forth many years ago by Sir Norman Lockyer in his dissociation hypothesis.

I make these observations in order that those working on the subject from the theoretical side may the better see the phenomena to be explained, which are quite different from ordinary dynamical vibrating systems.

In conclusion, I should like to direct attention to the importance of extending Messrs. Ladenburg and Loria's work. By examining every line in the spectrum of an element we could, for instance, say whether a line was faint because very few systems were emitting it, or whether its faintness must be attributed to the fact that the vibrations producing this line have only a very small amplitude.

ALBERT EAGLE.

Imperial College of Science and Technology, London, November 9.

A Gall-producing Dragon-fly.

WHEN looking through Dr. C. Houard's new work on galls ("Les Zoocécidies des Plantes d'Europe et du Bassin de la Méditerranée," tome i.), I was surprised to find on p. 249 an entry:—"Minime borselette *O. ped. Lestes viridis*, Van der Lind."

A gall-producing dragon-fly was quite new to me, but on looking up the subject I found a series of very important observations on the oviposition and larva of the species in question by the Abbé Pierre and M. de Rocquigny-Adanson, in the *Revue scientifique du Bourbonnais et du Centre de la France*, xv. and xvi. (1902–3), and the *Annales et Bulletin de la Société entomologique de France* for 1904. As these seem to have been entirely overlooked in England, I think it may be useful to epitomise them as briefly as possible.

The eggs of *Lestes viridis* are laid on the branches of a great variety of deciduous trees and shrubs, but always close to, or overhanging, water, and therefore probably most often on alders or willows. These result in the production of small galls, which are sometimes extremely abundant, and which are thus described by Pierre:—

"Un bourrelet mesure de 1 mm. ½ à 2 mm. de longueur, sur ½ ou 1 mm. de largeur. Deux bourrelets sont associés en chevron et forment un angle d'à peu près 90°, ouvert vers le bas du rameau. Le sommet de l'angle présente une pellicule corticale plus ou moins arrondie, formant clapet au dessus de l'ouverture par laquelle de 1 à 4 œufs ont été insérés sur chaque bourrelet. Enfin les chevrons distants de 2 mm., sont associés en série longitudinale, de telle façon qu'une même génératrice du rameau soit sensiblement bissectrice de tous les angles."

The emergence from the eggs and the structure of the larva are equally curious. The new-born larva, or "pro-larve," as Pierre calls it (*Ann. Soc. Ent. de France*, 1904, pp. 477–84, pl. iv.), resembles a coleopterous pupa, being enclosed in an outer membrane which leaves it only the power of leaping. If these young larvæ do not fall into the water on emerging from the egg, they leap about, sometimes for several hours, until they succeed in reaching it. After reaching the water the pro-larva rests on its back for two hours, and then casts the skin, a process occupying from three to thirteen minutes. The larval development of *Lestes viridis* has been compared by M. Giard to that of the crickets. A similar structure of the newly emerged larva has also been noticed in *Epithera bimaculata*, another dragon-fly.

I may remark that *Lestes viridis*, though common on the Continent, is an insect of great rarity with us, and not firmly established in the list of British species.

W. F. KIRBY.

THE GEOLOGY OF THE GRAMPIANS.[1]

THERE are few parts of the British Isles which can rival the southern Highlands of Scotland for beauty and variety of scenery. Over much of this district the genius of Scott has thrown the glamour of romance, and year after year crowds of tourists visit the scenes which he has rendered famous. The flat vales which lie to the south of the mountains (the plain of Strathmore) afford an excellent contrast to the bolder hill country behind them. Even the most stolid traveller who enters this region may be expected to feel some curiosity regarding the origin of the scenery and the history of the rocks which meet his eyes. Not a little has been written on this subject, but much of it is contained in scientific memoirs and periodicals which are beyond the grasp of the untrained geologist. The country, especially the Highland portion of it, is of great complexity, and its structure has given rise to discussions, many of which are far from settled at the present time. The task which the author of this work has essayed is one of considerable difficulty. He aims at giving an account of the geology and physiographical development of this intricate region which shall be intelligible to the unscientific and at the same time thoroughly abreast of the most recent researches. He has achieved a large measure of success even in the most difficult part, while some of his chapters, such as those on glaciation and scenery, are excellent. The result is a book which is at once interesting to the layman and useful to the professed geologist.

The great boundary fault which runs across Scotland from Stonehaven to the Firth of Clyde separates the Highlands from the valley of Strathmore, two districts which are as different in their geology as in their scenery and economic development. To the north lie metamorphic schists and gneisses of unknown age; to the south are fossiliferous Old Red Sandstone and Carboniferous rocks. One volume is assigned to each of these subdivisions. Much of the southern Highlands has been mapped by the Geological Survey, which has published maps (and in some cases memoirs also. Mr. Macnair is well known for his investigations on the metamorphic rocks of Perthshire, and is familiar with a large part of the area he undertakes to describe. His researches have led him to conclusions not essentially different from those of the Survey officers, whose opinions and observations he frequently quotes. He accepts the current theories that as we proceed northwards from the Highland border we pass over a succession of slates, grits, gneisses, mica schists, and limestones, which are not only apparently but actually in ascending order. They vary in lithological character and in degree of metamorphism, hut are essentially an unbroken and continuous succession, the quartzite of Schiehallion and Ben-y-gloe being the highest, while the grits and slates of Leny and Aberfoyle are the lowest rocks of the district. Two series of igneous rocks are found among the sedimentary schists, one older and another later than the period of folding and metamorphism. The former comprises the hornblendic schists, which are especially common around Loch Tay, and the acid gneisses of Ben Vuroch; among the latter may be placed the granitic bosses of Garabal Hill, Glen Lednock, &c. Mr. Macnair describes what, in his opinion, is the structure of the country, and gives sections showing a series of complex fans and synclinoria the axes of which have a north-east trend. Although these hypotheses are accepted by probably the majority of the geologists who are working in this district at the present time, they cannot by any means be regarded as established on any firm basis of proof. The apparent upward succession is quite possibly misleading. Many strong reasons may be advanced against it, and the structure is not more clear than the sequence. Apart from this, Mr. Macnair's account of the geology of the Grampians is clear and judicious, and may be recommended to those who wish to get a general idea of the subject without too much detail.

The second volume begins with a description of the

Photo. by W. L. Howie.

FIG. 1.—The Killin Hills, from the Dochart. From "Geology and Scenery of the Grampians."

Old Red Sandstone (Upper and Lower) of Strathmore. This vast sedimentary formation has always had a strong attraction for Scottish geologists. The author has given much time to its study; he discusses it with enthusiasm, and attempts to prove that, contrary to the usual opinion, the deposits are of marine origin, and at one time completely buried the Highland mountains. The arguments he brings forward are not new to geologists, and, we must confess, are, in our opinion, far from convincing; the old theories of Godwin Austen, Ramsay, and Sir A. Geikie are not yet disposed of and out of date. These chapters contain, however, many observations which are little known and well worth placing on record. The Carboniferous rocks occupy only a very small area, and are not otherwise important.

As might be expected in a region of such varied topography, the glacial and alluvial deposits are of considerable importance. The chapters devoted to them and to their effect on the scenery of this part of Scotland are the most readable in the book, and should prove interesting to anyone who cares for geology

[1] "The Geology and Scenery of the Grampians and the Valley of Strathmore. By Peter Macnair. 2 Vols. Vol. i., pp. xiv+195; vol. ii., pp. xii+199. (Glasgow: James MacLehose and Sons, 1908.) Price, 2 vols., 21s. net

or physiography. They are also free from the controversial matter which is rather obtrusive in the chapters on Highland schists and Old Red Sandstone. We must congratulate the author also on the excellence of the illustrations, most of which are from photographs. Many of them are very beautiful and appropriate, and should be of great help to those who are not specially versed in geological literature. An exception may be made in the case of some of the photomicrographs of rock sections, which are not up to the general high standard of the book. A really good geological map of the area described is also a desideratum which should be supplied if the book reaches a second edition, as we hope it will.

J. S. F.

Photo. by W. L. Howie

FIG. 2.—View from the summit of Ben Lawers looking north-east along th great axial line of folding. From "The Geology and Scenery of the Grampians."

THE LICK OBSERVATORY-CROCKER ECLIPSE EXPEDITION, JANUARY, 1908.

BY the courtesy of Prof. Campbell in furnishing advance proofs of Lick Observatory Bulletins Nos. 131 and 132, and from preliminary reports published by himself[1] and Dr. Albrecht,[2] we are able to form an idea of the perfect organisation of, and the results obtained by, the expedition from Lick Observatory which went to Flint Island to observe the total eclipse of the sun of January 3.

The whole of the expenses of the Lick expedition was defrayed by Mr. W. H. Crocker, this making the ninth occasion on which his generosity has rendered such an expedition feasible. The party was conveyed from Tahiti to Flint Island by the U.S. gunboat *Annapolis*, and arrived at the latter place, which is in latitude 11° S., and is 450 miles N.W. of Tahiti, on December 9, thus leaving twenty-four clear days for the erection and adjustment of the instruments. In addition to the Lick party, consisting of Prof. Campbell, Messrs. Perrine, Aitken and Albrecht, and Mrs. Campbell, the expedition included Prof. Lewis, of Berkeley, and Prof. Boss, and was accompanied by an expedition dispatched by the Smithsonian Institution; the latter consisted of Prof. Abbot and his assistant, Mr. A. F. Moore, who were charged with the task of making bolometric observations of the coronal radiations. Readers of NATURE will remember that this island was also selected by Mr. F. K. McClean as the *locale* of the expedition which he fitted up and carried through at his own expense, and Prof. Campbell remarks that they (the McClean party) were found to be "helpful and congenial companions."

The programme of the Lick observers comprised the determination of the contact times, the photography of the corona, on large and small scales, and of the coronal and chromospheric spectra, and a photographic search for any possible intra-mercurial planet. As Mr. McClean has already reported, the weather on the morning of the eclipse was extremely sensational, rain falling in torrents between five minutes before and two or three seconds after the commencement of totality, but happily the clouds dispersed, and the remainder of the eclipse was observed in a comparatively clear sky. That results were obtained which are likely to provide valuable additions to our knowledge of solar physics may be inferred from the following brief *résumé* of the preliminary reports of the observers.

The observations of the contacts showed that mid-eclipse took place some 27 seconds earlier, whilst totality lasted some 9 seconds less, than the predicted times.

In the intra-mercurial planet research two quadruple sets of cameras were employed, each set so arranged as to include an area 9° broad and 28° long in the direction of the sun's equator. Three hundred star images, going down to the ninth magnitude, were recorded, and all have been identified with known stars by Prof. Perrine. It now seems certain that no planet brighter than the seventh magnitude exists nearer the sun than Mercury, and, as it would need a large number of seventh-magnitude planets to account for the outstanding anomalies in the motion of Mercury, Dr. Albrecht considers that the observational side of this research should now be considered as closed. The *raison d'être* of the Mercury anomalies must be sought elsewhere; possibly, as suggested by Prof. Seeliger, the material responsible for the Zodiacal Light may be sufficient to account for them.

With the Floyd camera, having a Clark lens of 5 inches aperture and 67 inches focal length, fed by a 12-inch cœlostat, eight exposures, varying from "instantaneous" to 16 seconds, produced excellent

[1] Publications of the Astronomical Society of the Pacific, No. 119, April, 1908.

[2] The Journal of the Royal Astronomical Society of Canada, vol. ii., No. 3, p. 115.

negatives showing streamers two solar diameters in length. These long streamers are rather evenly distributed around the sun, but the strong inner corona is much more intense on the east and west than at the poles.

Prof. Campbell and Dr. Albrecht speak very highly of the simplicity and the performance of the 40-feet "tower camera" of 5 inches aperture, designed by Prof. Schaeberle for the 1893 eclipse. Fig. 1 is reproduced from an illustration accompanying the former's report in the Publications of the Astronomical Society of the Pacific, and shows the instrument, in position, at Flint Island. Many advantages are claimed for this form of "direct" instrument; among them the removal of the lens and a greater part of the tube from the ground region of intense atmospheric tremor, and the elimination of the possible distortion of a cœlostat mirror are not the least. Six exposures, varying from 2 to 64 seconds, were made, and the negatives show a wealth of coronal details. The chromospheric stratum is shown on the first and last photographs, and there is a large eruptive prominence in position-angle 214°. About fifteen streamers extending to $1\frac{1}{2}$ lunar diameters and a similar number extending to 1 lunar diameter are shown on the longer exposures. An unusually straight and slender streamer starts near the south point and extends, not radially, but in the direction of 190°, for about $1\frac{1}{2}$ diameters; during the last seven-ninths of its length this streamer is accompanied by a fainter branch which makes an angle of 4° with its axis. Comparisons of the photographic brightness of the corona, effected by impressing standard squares on some of the plates, show that almost all the effective photographic light came from the inner corona situated within 1′ or 2′ of the moon's edge.

A plate exposed, in a spectrograph with the plate continuously moving, for fifteen seconds on either side of the end of totality, shows a spectrum in excellent focus from λ 3800 to λ 5100 the linear scale being such that from λ 3700 to λ 5300 is 13 inches. Hundreds of bright lines, showing the depths and locations of the corresponding vapours, are recorded, and should furnish a wealth of information as to the sun's higher atmosphere.

A spectrograph fitted with quartz lenses, and prisms, of 9·2 cm. aperture and 1 metre focal length, was employed by Prof. Lewis to obtain photographs of the spectra of the corona and the "flash." A sliding diaphragm in front of the slit permitted comparison solar spectra to be obtained on the same plate, and an exposure of $3\frac{1}{4}$ minutes on the corona, with the slit tangential to the east limb, and a shorter exposure on the chromosphere were made immediately before, and at, third contact. The unexpected curtailment of totality caused the latter to be over-exposed, but some eighty chromospheric lines are seen projecting beyond the solar spectrum; the resulting spectra are some 14 cm. long from λ 3000 to D. Both the continuous and the line radiations of the corona are shown, and both apparently emanated from the inner corona within a region of less than a quarter of a radius from the photosphere. Fifteen certain, and ten doubtful, lines are recorded, and of the former those at λλ 5304, 3602·3 and 3390·7 are the strongest, the respective intensities being 10, 15 and 30. That neither Huff, in 1900, nor Dyson, in 1900, 1901 and 1905, recorded the strong line at λ 3602·3, and that the latter obtained lines not shown on his own spectra, is taken by Prof. Lewis as evidence supporting the idea of a variable corona.

In discussing the relative temperature of the corona, Prof. Lewis employs the principle enunciated by Stokes in 1876, and used by Lockyer in his researches on stellar temperatures. This principle depends upon a comparison of the relative amounts of the ultra-violet and the red radiations in the light-sources examined, predominance of the former denoting higher, and of the latter lower temperature. In Lockyer's stellar work it was found that by the assumption of this law the previous results depending upon the chemical classification of the stars were plenarily confirmed, and Prof. Lewis's conclusions are no less regular. Comparing the coronal with the solar spectrum, he finds that the latter is, relatively, much richer in violet light, and says, "hence it may be inferred that the corona is considerably colder than the sun." Subsequent comparative tests with a standard candle, allowing for the atmospheric absorption of the ultra-violet radiations, fix the lower limit of coronal temperature at considerably more than 2000° absolute.

FIG. 1.—The 40-ft. Coronagraph.

Some eighty-two chromospheric lines, between λλ 3109·8 and 4863·0, with identifications from Rowland's tables and Dyson's eclipse paper, are given, but, with only the tips of the lines projecting from the dense, over-exposed spectrum, the wave-lengths are, naturally, only approximate.

For the examination of polarisation effects in the corona, four exposures, varying from two to six seconds each, were made with each of the four cameras arranged for this purpose. Each photograph shows marked polarisation in all parts of the corona, and a comparative study of the series should, incidentally, produce valuable information concerning the effect of clouds on such photographs, for during one exposure a cloud passed over the southern half of the corona, leaving the northern half cloud-free.

With two single-prism spectrographs, specially designed by Prof. Campbell, three photographs of the coronal spectrum were obtained, the slits being placed east and west across the centre of the solar image. With the first, a good spectrum of the extreme inner corona, extending from λ 3550 to λ 5390, was obtained during an exposure of 3m. 40s. Both the line at λ 5303 and an apparently new line at λ 3601·3, also obtained by Prof. Lewis, are recorded strongly, each extending to 3′ from the west, and 2′ from the east, limb; the line at λ 3987·0 is faintly, and that at λ 4231·5 is easily, visible, whilst another apparently new, and faint, line shows at λ 3625·5. The absorption lines are seen most readily in the regions lying between 10′ and 20′ from the limb, but are quite faint in the outer, and apparently absent from the inner, corona. A comparison of the continuous spectrum with solar spectra taken with the same instrument at Mount Hamilton indicates, again, a lower temperature for the former, although, in the absence of further details as to the similar treatment of the photographs considered, this evidence is not so conclusive as that educed by Prof. Lewis.

With the second single-prism spectrograph, Cramer isochromatic plates were used and good spectra, extending from λ 3600 to λ 6000, obtained, the general features being the same as in the preceding spectrum. Measures of the green line give its wave-length as 5301·4±0·5.

Owing to the inter-diffusion of the bright-line, the continuous, and the absorption spectra, these coronal spectrograms are rather difficult to interpret, but it appears certain that the radiations of the outer corona, of, say, more than 20′ from the moon, are either not recorded at all or are masked by the diffused spectrum of the brighter inner corona. The proportion of the light radiated by the coronal particles at this eclipse appears to have been relatively great as compared with the amount of sunlight diffused by them, but whether this is due to variability in the corona or to the interference of light clouds at the previous eclipses is a question which Prof. Campbell and Dr. Albrecht leave for future consideration. To those observers who had had previous eclipse experience, the outer corona on this occasion appeared disappointingly faint.

It is unnecessary here to enter into the numerous details given by Prof. Abbot concerning his bolometric apparatus, but several important modifications of that previously employed had been made for this eclipse, chiefly with the object of restricting the operative radiations during each observation to that definite, small area of the corona that was under actual observation. Preliminary observations of the relative brightness of the sun, of the sky at different distances from the sun, and of the moon were made before eclipse day, and the results are shown below. Tests were also made of the quality of the light from each of these sources, the criterion being the proportional transmissibility of the various rays by an ashphaltum screen. For sun, sky and moon the proportions of light transmitted were 0·29 to 0·37, 0·25 and 0·50 respectively, the difference sky-moon being due, presumably, to the size and nature of the reflecting particles. These results lead to the inference that if the brightness of the corona be due merely to reflected ordinary sun rays, the transmissibility of the rays will be greater if the reflecting particles be of the grossness of those composing the lunar surface, and less if they are minute like the molecules of gases.

During the eclipse, observations were made with the sun in six different positions in regard to the cross-wires of the finder, the latter being crossed to form angles of 75° and 105°. In positions i. and ii. the moon's image was tangent in one of the obtuse angles, and in iii. in one of the acute angles; this meant that in i. and ii. the bolometer was central on points 4′ of arc beyond the extremities of a lunar diameter inclined 52°·5 to the E. and W. diameter; whilst in iii. the distance of the moon's limb was about 12′ of arc. In positions iv. and v. the wires were 1′·5 of arc beyond the extremities of the moon's diameter, east and west respectively, and in vi. they intersected at the centre of the dark moon. The observations showed that the transmissibility of the inner coronal radiations, which passed through a screen transmitting light of less wave-length than 3 μ, was 0·364; on the same day the mean transmissibility of the solar radiations was found to be 0·332. The whole of the reduced results are collected in the following table, taking the sun's brightness as 10,000,000:—

	Brightness
Sun, near zenith (Flint Island)	10,000,000
Sky, 20° from sun ,, ...	140
,, distant from sun ,, ...	31
,, average ,, ...	62
,, ,, previously measured at Mount Wilson	15
Corona, positions iv. and v.	13
,, ,, i. ,, ii.	4
Moon, about zenith distance 50° (Flint Island)...	12 (?)

In positions iii. and vi. the galvanometer showed no deflection.

Several significant facts appear from these figures, of which two call for special mention. The first is that at sea-level (Flint Island) the sky is some four times as bright as observed at an altitude of 1800 metres (Mount Wilson), thus showing the profound importance of establishing our observatories in the higher altitudes. Secondly, the brightness of the sky at 20° from the sun is to that of the corona as 140 : 13; nearer the sun the ratio would be enormously increased, and it therefore appears that to obtain photographs of the corona without waiting for an eclipse is unpromising, to say the least.

Summing up the evidence now available, Prof. Abbot believes that the best explanation of the character of the coronal radiation is that it is, in the main, due to reflected sunlight. The apparent absence of polarisation need not weaken this supposition, for, owing to the fact that they receive light from the solid angle of a whole hemisphere of the sun, the particles of the inner corona would be partially polarised in many directions, and therefore exhibit no definite polarisation in any one. The observed modification of the reflected solar spectrum may be due to the fact that the bright emissions from the heated particles close to the sun are sufficient to obliterate the absorption lines; further out the particles would be cooler—perhaps mainly solid and liquid—and the emission spectrum would then diminish, the absorption spectrum, as a consequence, appearing gradually. But as the light is still reflected sunlight only its intensity would diminish and its character and transmissibility would remain the same, as the observations show that they do.

Whilst recognising fully the difficulty of accounting rigidly for all the observed phenomena, Prof. Abbot concludes that in all probability the brightness of the corona is mainly due to reflected ordinary sunlight, diluted to some extent by the emissions from incandescent particles, and possibly, also, by some small amount of "luminescence" such as produces the aurora.

WILLIAM E. ROLSTON.

THE PRESERVATION OF THE NATIVE FAUNA AND FLORA IN AUSTRALASIA.

We are glad to see that the New Zealand Government is actively continuing the work of preserving the natural scenery of the dominion to which we directed attention last year. Some interesting particulars are given in the Report on Scenery Preservation for the year 1907-8 lately issued by the Department of Lands, from which it is evident that the authorities fully appreciate the value of the remarkable natural attractions for which the Dominion is so justly famous. During the year under review an addition of more than 8000 acres was made to the area reserved under the Scenery Preservation and Public Works Acts. This area now reaches a total of about 54,000 acres, exclusive of 100,000 acres of Crown land similarly reserved under the Land Act.

The public of New Zealand appears to be as much interested in the good work as the Government, considerable sums having been raised by subscription for the purchase of special areas in the neighbourhood of some of the large towns. Let us hope that they will not forget to reserve a sufficient belt along the coast-line, so that future generations may be protected from attempts on the part of grasping landlords to prevent the public from making full use of the seashore, such as have lately given rise to so much dissatisfaction in our own country.

The proper care of the areas reserved appears to be a matter of no little trouble and expense. Where they are covered with forest there is the constantly recurring danger of bush-fires and damage by stock. As the inspector of scenic reserves remarks in his report, swaggers and Maoris appear to set fire to the country as if they were inspired by a spirit of destruction, and settlers, in clearing their own lands, are indifferent to the damage their fires may cause by spreading on to the lands of the Crown.

One of the most beneficial results of the reservation of these large areas of native bush is seen in the preservation from destruction of the native birds. We quote again from the subsidiary report of Mr. E. Phillips Turner, the inspector of scenic reserves:

> "In the Canterbury reserves I found that the native birds (with the exception of the tui, which in Akaroa is still fairly plentiful) are getting very scarce. In Otago the larger size of the reserves has served as a more effectual sanctuary, and tuis, bell-birds, and tomtits were fairly plentiful, whilst fantails, robins, wrens, parrakeets, kakas, and pigeons were also seen."

The author of the main report is, we think, rather unnecessarily severe upon the New Zealand botanists. After very properly directing attention to "the interesting and valuable report on a botanical survey of the Tongariro National Park, by Dr. Cockayne," he observes:—

> "Nowhere in the world are such beautiful and rare plants and trees to be found as in New Zealand, and the time is not far distant when this will be widely recognised, and visitors from abroad will undertake what our own students have overlooked."

It is only a few months since we had occasion to notice an extremely interesting and beautifully illustrated work on the New Zealand flora by two local botanists,[1] and it seems to us that a surprising amount of good work of this kind has been done by New Zealand students; witness the valuable publications of the New Zealand Institute during the past thirty or forty years. There are not many people in New Zealand who can afford to devote their lives to such work gratuitously, but we have little doubt that if the New Zealand Government extended to local naturalists sufficient encouragement, there would be no lack of competent investigators eager to enter the field. If the "visitors from abroad" are able to undertake the work, it is largely on account of the generous assistance and encouragement which they receive both from the authorities in their own country and those in New Zealand.

[1] Laing and Blackwell, "Plants of New Zealand."

The report is again copiously illustrated by photographs of some of the more remarkable scenery, one of which, taken on the Wanganui River, we reproduce. This river is said to have "no equal in the world as regards its botanical and scenic attractions," and the photographs certainly go a long way to support the claim.

Two reports by Dr. Cockayne, lately published by the New Zealand Department of Lands, have also reached us, the one referred to above as a botanical survey of the Tongariro National Park, and the other as a botanical survey of the Waiporra Kauri Forest. These are also copiously illustrated by excellent photographs, and should prove of great interest to botanists all over the world. The report on the Tongariro National Park contains an extremely interesting chapter on the geology of this remarkable volcanic district, by Mr. R. Speight. The photograph of the summit of Mount Ruapehu, showing a hot and sometimes boiling lake surrounded by ice-cliffs, is particularly striking.

Wanganui River Scenery—Mangaro, sixty-six miles from Wanganui.

We further observe with much satisfaction that the various societies interested in natural history in the Commonwealth of Australia are making a vigorous and combined effort to arouse the Federal Government to a full sense of its responsibilities with regard to the preservation of the native fauna. The movement which has lately taken place in England in relation to the protection of birds, and which culminated in Lord Avebury's Bill, appears to be largely responsible for the renewed interest which is being

taken in these matters in Australia. The Royal Societies of South Australia and New South Wales, the advisory committee *re* Fisheries and Game Acts in Victoria, and the Linnean, Zoological, and Animals' Protection Societies of New South Wales are all taking an active part in furthering the good cause. An influential deputation, headed by Prof. W. Baldwin Spencer, F.R.S., has already waited upon the Prime Minister of the Commonwealth, on August 4, in regard to the prohibition of the exportation of the skins and plumes of Australian birds, and was most favourably received. It must not be supposed, of course, that nothing has already been done to secure the preservation of the native fauna of Australia; this is by no means the case. Some of the most interesting animals, such as the platypus and the lyre bird, have, we believe, been more or less protected for a long time, but it is felt, and rightly, that existing legislation is not sufficient, and that if the native fauna is not to disappear in the near future, much more vigorous action must be taken. We wish the new movement in this direction every success, and cannot doubt that it will be followed by excellent results.

ARTHUR DENDY.

PROF. WILLIAM EDWARD AYRTON, F.R.S.

On Sunday, November 8, Prof. Ayrton died at the age of sixty-one. During the last four years he was in danger on account of excessive blood-pressure. The immediate cause of death was influenza, followed by bronchitis and heart failure.

He was the son of an able barrister and the nephew of the Rt. Hon. Acton Ayrton, a Minister in Gladstone's Government from 1869 to 1874. I have before me the history of the Ayrton family for the last three hundred years, a family of able lawyers, musicians, surgeons, clergymen, university dons, and schoolmasters. He went to University College School, London, where he gained numerous prizes; at University College he gained the Andrews exhibition in 1865 and the Andrews scholarship in 1866. He passed the first B.A. examination with honours, and then became a pupil of Lord Kelvin in preparation for the Indian Telegraph Service. His eulogistic account of how Lord Kelvin dealt with his students, published in the *Times* about the beginning of this year, was greatly praised in NATURE a short time ago. In style and force it will compare favourably with anything written in the English language. He was not only a fine writer, he was also a brilliant speaker. He seldom needed notes in speaking. Twenty years ago, at the Paris Exhibition, he gave a long lecture in French, using no notes, and French critics described it as being nearly perfect in style and enunciation. In India he did good work with the late Mr. Schwendler, and became electrical superintendent of the Telegraph Department. In 1872–3 he was on special duty in England, and acted also for Lord Kelvin and Prof. Jenkin, the engineers of the Great Western Telegraph Cable. From 1873 to 1878 he was professor of natural philosophy and instructor in telegraphy in the Imperial College of Engineering, Tokio, Japan.

I gave a short account of Ayrton's Japanese laboratory in a paper read before the Society of Arts in January, 1880. I venture to think that nobody interested in the history of scientific education can afford to neglect that paper. It describes the educational ideas which had gradually been developed in Japan. At Glasgow and Cambridge and Berlin there were three great personalities, but, except for these, the laboratories of Kelvin, of Maxwell, and of Helmholtz were not to be mentioned in comparison with that of Ayrton. When I went to Japan in 1875, what I found were fine buildings, splendid apparatus, carefully chosen and often designed by himself, and earnest, diligent students; I found also a never-resting, energetic, keen-eyed chief of great originality and individuality. It is no wonder that Maxwell jestingly said that the electrical centre of gravity had shifted towards Japan. It must be remembered that at that time there were not half-a-dozen people in Great Britain who had experimented in electricity.

Before 1875 he had published papers on telegraphy; after 1875 his investigations were mainly on electrical phenomena, sometimes without, but oftener with, a practical bearing on engineering.

From 1879 to 1884 Ayrton was professor of applied physics at the City and Guilds Technical College, Finsbury. It may already be forgotten that the system of instruction created there was radically different from anything which previously existed. It is now to be found in every technical college of this country. Students learnt by actually doing things in the laboratories and workshops. The most important thing leading to success was that there were no outside examiners. Hitherto professors had merely shown experiments at the lecture table. In one or two mechanical laboratories a few students looked on whilst the professor broke specimens with a 200-ton testing-machine or made tests on a steam engine. Only a few volunteer students had a chance of making experiments in physics anywhere. Ayrton gave interesting work to all students, and induced them to think things out for themselves. The motors and dynamos and other contrivances which were tested were not so small as to be toys, and they were not so large but that they could be left in charge of the average student without fear of disaster. The preliminary work was particularly Ayrton's invention, and as to this his book on Practical Electricity ought to be consulted. He said:—in the study of mechanics and other parts of science we deal with weight, inertia, stress, colour, &c., and a boy's senses have made such things tangible. But in electricity we deal with something almost abstract, and there must be a regular training which will make the things which we call current and voltage and resistance and magnetic induction just as tangible to the student as weight is.

Again, Ayrton never tried to create the perfect engineer. He aimed at creating a learner, a person with developed common sense, a man who would learn engineering when he had the chance of practice, a man whose education would go on until he died, a man who could use books, a man fond of reading. It is difficult now to say how much of his system is due to colleagues like Armstrong and myself. We had the same ideas, we never quarrelled, we never seemed to differ in opinion; on any given question we seemed always to come to the same conclusions. No mere chemist taught chemistry, no mere mathematician taught mathematics, no mere physicist taught physics, no mere specialist taught anything at that college. Practical and descriptive geometry and graphics were taught, and almost no deductive geometry or geometrical conics. Ninety per cent. of the usual work in algebra and trigonometry was put aside as unnecessary trickery. Analytical conic sections gave place to the calculus study of curves in general. Before 1879 squared paper was expensive; in 1879 Ayrton arranged that it could be bought at sixpence a quire. Every subject was taught through the other subjects. I am afraid that the average student would have failed to pass any outside examination in any of the subjects, but he had a wonderful power of using on any new

problem his very thorough acquaintance with a few fundamental principles.

No marks were ever given for lecture notes, but rough laboratory notes and finished accounts of laboratory work in good English, with elaborate sketches and squared-paper curves, were thought most important. When a hundred students pass through laboratories of no large dimensions in one week, some system must be adopted, and the education cannot be ideally perfect, especially when the number of instructors is limited. But great encouragement was given to any student who adventured and discovered things of which he had not been told anything. Advanced students had fine opportunities for original research.

From 1884 until he died Ayrton was professor of electrical engineering at the City and Guilds Central College, South Kensington. The laboratory here became a sort of developed combination of that at Finsbury and the one in Japan. In my opinion, there is no electrical laboratory in the world that can compare with the Kensington laboratory, whether we look at it from the educational or from the research point of view. He always said that much of its success was due to the helpfulness of Mr. Mather.

In dealing with students, that earnestness and enthusiasm and inspiration, that training in scientific method, that sympathy and helpfulness for others which he received from Lord Kelvin, he handed on to many thousands of pupils, and they in turn are handing them on to new generations.

"The Electricians' Directory" speaks of about 150 papers published, usually in collaboration with myself, Mather, and others, in the Proceedings and Transactions of the Royal Society, Physical Society, Institution of Electrical Engineers, and other societies, giving the titles of the most important, and it gives the names of some of the numerous inventions with which Ayrton alone or with others has benefited the world. The time from 1879 to 1884 was a particularly happy one. There are now hundreds of schools where men may learn electrical science; in most of them his pupils are teaching. There are now thousands of electrical engineers in whose employment a man can obtain experience. But at that time there was only one school, there was almost only one office in which and there was almost only one engineer in whose service, education and experience could be found. Every young man of promise, every engineer with ambition, was attracted from Germany, America, and elsewhere to the place where new discoveries and new inventions were the order of the day. It was a glorious time, that pioneering time when everything planted was fruitful, when everything tried was successful. Those discoveries are now such common knowledge, those inventions are such usual parts of all electrical machinery, that nobody dreams of mentioning their author's name in connection with them.

I remember once, in 1886, sitting at a meeting of the Institution of Electrical Engineers beside Prof. Ayrton, and, looking over the large audience, I was able to say that nearly three-quarters of the people present were Ayrton's old students.

He loved the Institution of Electrical Engineers, and it was no wonder, for it was the mirror of his life. It gave a setting and a value to all his life's work and all he cared for. It gave a scope for that energy, that earnestness, that untiring industry, that hatred of inaction which was his most intense characteristic. He was a member of it almost from the beginning; his speeches during discussions form some of the best reading in its proceedings; he was a diligent attender at general meetings, at council meetings, and at meetings of the numerous committees. His love for it was that of a nurse or mother for the boy whom she has seen grow up to splendid manhood.

Since 1879, when he lectured on electrical transmission of power at Sheffield, Prof. Ayrton delivered many popular lectures, and each of them may be said to have been epoch-making. He acted on many juries and congresses. He was president of Section A of the British Association in 1898, president of the Physical Society in 1890, president of the Institution of Electrical Engineers in 1892. He became a Fellow of the Royal Society in 1881, and in 1901 he was awarded a Royal medal by the Royal Society for his scientific work.

His first wife was his cousin, Matilda Chaplin, one of the famous pioneering Edinburgh medical students; their daughter Edith, now Mrs. Israel Zangwill, was born in Japan. His second wife is well known as the only woman member of the Institution of Electrical Engineers; she was awarded the Hughes medal of the Royal Society for her scientific work in 1906; their daughter Barbara has already published a physiological investigation.

When I first knew him in Japan the motto printed on his notepaper was "Energy." It was his motto through life, or rather his motto was "Earnestness."

He had a keen sense of justice and a high regard for truth. His mere presence often caused the tone of conversation to be raised. The ideals towards which he worked incessantly were noble ideals. In his own lifetime great progress had been made towards their realisation, but occasionally he was despondent, particularly towards the end, when his ailing body could not respond to his vehement spirit. He could not see that all the noble things for which he had worked were being worked for now by numerous energetic young men, most of whom had been inspired by himself. It was sad to watch him towards the end, the active mind warring with the weak body. I felt often that I wanted to say with Kent in the old play, "O, let him pass! He hates him that would upon the rack of this rough world stretch him out longer."

JOHN PERRY.

NOTES.

SIR WILLIAM RAMSAY, K.C.B., F.R.S., and Dr. G. W. Hill have been elected corresponding members of the Bavarian Academy of Sciences.

M. LOUIS-FÉLIX HENNEGUY, professor of comparative embryogeny in the Collège de France, has been elected a member of the Paris Academy of Sciences.

MR. JAMES SWINBURNE, F.R.S., has been elected president of the Junior Institution of Engineers, in succession to the late M. Gustave Canet.

WE learn from *Science* that the Nichols medal of the American Chemical Society has been awarded to Prof. W. A. Noyes, of the University of Illinois, and Dr. H. C. P. Weber, for their researches on the atomic weight of chlorine.

THE Royal Statistical Society offers the "Howard medal" (bronze) and a grant of 20*l.* for the best essay on a statistical study of infantile mortality in Great Britain and Ireland and of its causes. The competition is open, and is not limited to Fellows of the Statistical Society. Essays must be sent in before June 20, 1909.

THE eighty-third Christmas course of juvenile lectures, founded at the Royal Institution in 1826 by Michael Faraday, will be delivered this year by Prof. William Stirling, his subject being "The Wheel of Life." The

course, which will be fully illustrated, will commence on Tuesday, December 29, and will be continued on December 31, 1908, January 2, 5, 7, and 9, 1909.

THE fiftieth anniversary of the foundation of the British Ornithologists' Union will be celebrated by a special meeting in the rooms of the Zoological Society on Wednesday, December 9, at 3 p.m. Only four of the original members still survive—Dr. F. Ducane Godman, F.R.S., Mr. Percy S. Godman, Mr. W. H. Hudleston, F.R.S., and Dr. P. L. Sclater, F.R.S.—and at the close of the meeting commemorative gold medals will be presented to them.

AT the annual general meeting of the London Mathematical Society, held on November 12, the following were elected to be the council and officers of the society for the session 1908–9:—*President*, Sir William Niven; *vice-presidents*, Mr. A. Berry, Prof. W. Burnside, Prof. H. M. Macdonald; *treasurer*, Prof. J. Larmor; *secretaries*, Prof. A. E. H. Love, Mr. J. H. Grace; *other members of the council*, Dr. H. F. Baker, Mr. G. T. Bennett, Mr. A. L. Dixon, Prof. E. B. Elliott, Dr. L. N. G. Filon, Dr. E. W. Hobson, Major P. A. MacMahon, Mr. H. W. Richmond, Mr. A. E. Western.

A FEW weeks ago Sir J. H. Carruthers directed attention to the fact that there is no monument in London to commemorate the life-work of Captain Cook. Admiral Lord Charles Scott and other representatives of the Royal Navy have expressed cordial approval of the proposal to erect such a monument to the great navigator. "A large number of us have had reason," they add, "when following our vocation, to feel personally grateful to him for the care with which he carried out his explorations and the accuracy of his hydrographical surveys." It is hoped that the proposal to establish some public memorial of Captain Cook will receive generous support from the British public.

THE death of M. Alfred Ditte, professor of inorganic chemistry at the Sorbonne, adds yet another to the long list of losses sustained by the Academy of Sciences during the past year. This distinguished chemist, although not prominently identified with any epoch-making discovery, made numerous important contributions to inorganic chemistry. The pupil of Deville, Ditte's earlier papers furnished experimental material confirming the theory of dissociation. In this connection may be mentioned his work on the formation and decomposition of the hydrogen compounds of selenium and tellurium, and the same idea of the equilibrium of chemical reactions led to his researches on the action of water on antimony chloride, mercuric sulphate, and bismuth nitrate. The conditions governing the artificial production of crystallised minerals were also thoroughly worked out by him, and gave rise to a long series of memoirs. Ditte published no joint papers, his work being entirely personal, and the same individuality was exercised in his professorial work, especially in his laboratory instruction. He was elected a member of the Academy of Sciences in 1897, in succession to Schutzenberger.

THE Government of Madras has approved, we learn from the *Pioneer Mail*, the recommendation of the recent industrial conference that there should be a special department under a special officer to deal with industrial questions. This officer will be styled Director of Industries. In carrying out industrial development the Government consider immediate action is possible as regards the establishment of an industrial museum, the preparation of a list of manufactures in the Presidency of sufficient importance to justify the establishment of special industrial schools in relation to them, and in other directions. The director is to submit proposals for giving effect to the recommendations of the conference in regard to the establishment of six weaving institutions on the lines of the Manchester or Bradford textile schools at six centres in the Presidency, each under an Indian expert; the employment of a dyeing expert to report on the state of that industry in the Presidency; the establishment of a leather-trade school with a small tannery attached; the offer of a reward for the design of a suitable oil-extracting plant and the introduction of improved oil presses, &c.; and the extension of well-boring operations.

FROM the *Times* of November 14 we gather the following remarks, contributed by a correspondent, upon the work of Dr. James Fletcher, the Dominion entomologist, whose death was announced last week: So long ago as 1870 Dr. Fletcher was vice-president of the Entomological Society of Ontario and part editor of their annual reports, to which he had contributed a paper on Canadian beetles in the previous year; and from this time until his death he worked hard at Canadian entomology and botany, and published numerous papers and reports, chiefly on economic entomology and on the habits and transformations of insects, in various Canadian journals, especially in the *Canadian Entomologist*, of which he became assistant editor in 1887, about the time that he was appointed Dominion entomologist and botanist to the exeprimental farms at Ottawa. Here he set himself energetically to combat insect pests, which are far more destructive in the American continent than in Europe, and his exertions were so much appreciated that he was called "the farmers' friend" throughout Canada. Nor did he neglect botany, for he published a "Flora Ottawaensis" in the Transactions of the Ottawa Field Club, vols. i.–v. (1880–4), and again in the *Ottawa Naturalist*, vols. ii.–vii. (from 1888 onwards).

THE first general meeting of the Institute of Metals, formed in June last, was held in Birmingham on November 11 and 12 under the presidency of Sir William White, K.C.B. The institute already has a membership of about 350, and a considerable number of members from all parts of the country attended, and were cordially welcomed by the Lord Mayor of Birmingham (Mr. G. H. Kenrick). The president's address, which dealt with the aims of the institute and the part which manufacturers, users, and scientific investigators may be expected to play in its development, aroused the keenest interest. An excellent list of papers for reading and discussion was forthcoming, the most notable being those by Mr. J. T. Milton and Mr. A. Phillip on the practical side, and by Mr. C. Desch and Mr. W. Rosenhain on the scientific study of non-ferrous alloys. In the majority of cases the papers were adjourned for further discussion at the London meeting on January 19 and 20. It is a matter of congratulation that the Birmingham metal works have interested themselves so keenly in the formation of the institute, and that a strong local committee was formed the invitation of which to hold the first meeting in this important centre of the metal industry was gladly accepted by the council of the institute. Excellent arrangements were made for the reception of members and visitors. Visits to some of the chief metal works were carried through, a reception was held by Sir Oliver Lodge at the new university buildings, followed by an inspection of various departments, and special mention must be made of an exhibit at the

conversazione of upwards of 100 "diseased" metals and alloys which had been collected at the instigation of Mr. Boeddicker, the chairman of the local committee. It is to be hoped that this display of metals and alloys which have failed from obscure causes will lead to much valuable research work being set in hand. Certain it is that in the corrosion of metals the institute has a magnificent field of investigation. The meetings were a pronounced success; the institute has justified its establishment, and now takes its place among the technical institutions of this country.

The first number of the Bulletin of the Sleeping Sickness Bureau has been published by the Royal Society, bearing date October, 1908, and is edited by the director, Dr. A. G. Bagshawe. It deals with the chemotherapy of trypanosomiasis, and contains a clearly written summary and review of the results hitherto obtained in the treatment with drugs of diseases caused by trypanosomes, with references to 197 memoirs. The subject is dealt with under the headings "Treatment of Trypanosomiasis in Man," "Biological Accommodation of Trypanosomes to Chemotherapeutic Agents," and "Treatment of Experimental Animals," after which the editor draws some conclusions and lays down some principles which, in his opinion, have been established by this vast accumulation of experimental research. The publication is a most valuable one, and will undoubtedly be of great use to those engaged in research or practice in this field by putting clearly before them what has been achieved, and suggesting lines of investigation to be followed.

Polychætous annelids collected off the Pacific coast of North America by the U.S. steamer *Albatross* in 1903 form the subject of a paper by Mr. J. P. Moore in the Proceedings of the Academy of Natural Sciences of Philadelphia for June last. Out of 107 species collected, forty-seven are considered to be new.

Among the contents of vol. iii., part i., of the Transactions of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne is a paper by Mr. A. Randell Jackson on rare arachnids captured in Britain during 1907. Three of these are new to the British fauna, two being new species, of which one appears to be indigenous, while the second is introduced; the third is a continental species of the attid or jumping group. Of three other species only one sex had hitherto been recorded in our islands.

Spiders likewise form the subject of an article in the *Bulletin international de l'Académie des Sciences de Cracovie* for June, Mr. Vl. Kulczyński treating therein of the Javan and Sumatran representatives of the groups Mygalomorphæ and Cribellatæ. Some of the specimens described were collected at Palembaug, in Sumatra, others in the islands of the Batu, Krakatau, and Babo groups, and yet others in Java itself, more especially in the mountains. A considerable number of new species and races is named and described.

Students of variation should be interested in an elaborate paper by Dr. A. Brožek, of Prague, on the variability and local forms of the decapod crustacean *Palaemonetes varians* from four different localities, published in the *Sitzungsberichte der k. Bohm. Gesellschaft der Wissenschaften* for 1907. Two of the four localities are so far apart as Plymouth and Montenegro, and the variations—in the number and form of the "teeth" of the rostrum—are expressed in figures. It is noteworthy that the variability displays a marked tendency to asymmetry, and the author divides this asymmetrical variation into a "positive" southern and a "negative" northern type.

The damage caused to cotton in India by the caterpillars of the cotton leaf-roller moth (*Sylepta derogata*, or *multilinearis*) is discussed by Mr. H. Maxwell-Lefroy in Entomological Bulletin, vol. ii., No. 6, of Memoirs of the Department of Agriculture in India. While this common pest does not, as a rule, inflict much harm on native Indian cotton, it is extremely injurious to introduced American and Egyptian strains, destroying in some instances almost the entire crop. Whether these foreign cottons will eventually become more immune to attack remains to be seen.

The intra-uterine development of the hedgehog appears to have received but little attention at the hands of embryologists, despite the fact that the group is one of the most ancient of all mammals, and therefore likely to yield interesting results in this respect. As regards the age of the group, it may be mentioned that both the extinct Necrogymnurus and the existing Erinaceus are represented in the Oligocene phosphorites of central France, the persistence of the second genus being attributed to the defensive coat of spines with which its members are furnished. Recently Mr. H. Jacobfeuerborn has investigated the development of the hedgehog, with especial reference to the time of the acquisition of the external form during intra-uterine life, which he finds to be unusually early. The results of the investigation are published in the *Zeitschrift fur wissenschaftliche Zoologie*, vol. xci., part i.

The relations of the fauna of Central Europe to the Glacial period form the subject of a long and interesting paper by Prof. F. Zschokke, of Basle, published in the *Verhandlungen der deutschen Zoologischen Gesellschaft* for 1908. The paper is illustrated by two of Geinitz's maps, showing the maximum glaciation of North and Central Europe. Although at first bringing death and destruction in its train, the Ice-age should be regarded, in the author's opinion, as a great vivifying factor, exciting the fauna to active and passive migrations, and thus extending the distribution of the various species both on land and in water. The author has much to say regarding the spread in Central Europe of Nehring's "steppe-fauna" from the direction of the Ostsee, and adds that subsequently to this there must have been a great northern post-Glacial migration of southern animals and plants. The article is of such interest as to be well worthy of translation into English.

To the October number (vol. xliii., part i.) of the *Journal of Anatomy and Physiology* Prof. O. C. Bradley contributes an important paper on the morphology and development of the mammalian liver. Basing his conclusions largely on development, the author is of opinion that the liver is primarily an organ of more simple structure than was supposed to be the case by the late Sir W. H. Flower, consisting of three, in place of six, main lobes. The difference between the two views will be rendered most easily apparent by the following table:—

Bradley		Flower.
Central lobe ...	Right lobule	Right central lobe
	Left lobule	Left central lobe
Right lateral lobe	Main part	Right lateral lobe
	Processus caudatus	Caudate lobe
	Processus omentalis or papillaris	
Left lateral lobe		Left lateral lobe

The division of the central lobe into two is dependent on the presence of an "umbilical fissure," and is therefore not primary. The three fundamental lobes make their appearance independently, and develop in connection with different embryonic veins, the central lobe being produced

about the umbilical veins, while the right and left lobes grow along the course of the corresponding omphalo-mesenteric veins. The origin of the hepatic fissures cannot yet be satisfactorily explained.

A PHYTOGEOGRAPHICAL study of the Bonin Islands is contributed by Dr. A. Hattori to the Journal (vol. xxiii., art. 10) of the Royal College of Science, Tokyo. Although the average monthly temperature seldom exceeds 27° C., the vegetation is tropical in character, and shows close affinities with the flora of Formosa. A considerable proportion of Indian and Ceylonese plants, consisting largely of coastal plants, suggests the importance of sea transportation. A single endemic genus, Boninia (Rutaceæ), is recorded, and thirty endemic species, or about 14 per cent. of the total. The screw-pine, *Pandanus boninensis*, an endemic species, thrives generally, and in one locality forms a pure forest; the palms *Livistona chinensis* and *Ptycosperma elegans* are prominent, also the fern trees *Alsophila Bongardiana* and *Cyathea spinulosa*.

AN impressive volume, copiously supplied with illustrations, has been compiled by Dr. D. T. Macdougal, of the Desert Botanical Laboratory connected with the Carnegie Institution at Washington; he discusses therein the botanical features of the North American deserts. The volume contains the essence of previously published reports on deserts in Texas, Mexico, and California, and concludes with some general remarks on deserts and desert plants. On the subject of temperatures it is noted that in the soil around the roots of plants temperatures were measured up to 43° C., and the readings obtained by inserting the bulbs of thermometers into Opuntia stems ranged from 27° C. to 43° C. Again, it was observed that on occasions a difference of 20° C. existed between the temperature of the air and soil surrounding the stem and root of the same plant. These facts, it will be seen, do not harmonise with generally accepted ideas.

WE have received early numbers of the new periodical *Archiv fur Zellforschung*, edited by Dr. R. Goldschmidt, intended, as the title implies, for the publication of original communications on cytology. The first part, issued in February, was inaugurated with a paper by Dr. R. Hertwig on modern problems of cell-science, in which he discusses the function of the nucleus and the nature of its influence. He elaborates his theory of a relation existing between the nucleus and the protoplasm, whereby the phenomena of division and other changes in the cell are regarded as a release of the tension set up by a departure from the normal proportion. An important contribution to the same subject is made by Dr. M. Popoff, wherein he details his experiments with Infusoria to obtain data for working out the proportion mentioned. The tabulated curves are of great interest, also the reasoning as to a chemico-physical ultimate cause. Dr. G. Tischler communicates the results of cytological investigations with sterile plant hybrids, but is unable to offer any explanation of the determining influence. Other contributions relate to the chromosomes, the formation of sperms in the Myxinoideæ, and Dr. Goldschmidt traces the chromatin changes in the egg of *Distomum lanceolatum*.

MESSRS. GUSTAV FISCHER, of Jena, have published a very useful and interesting booklet, by Dr. P. Schatiloff, explanatory of Ehrlich's "side-chain theory," and illustrated with several diagrams ("Die ehrlichsche Seitenkettentheorie," pp. 56, price 2 marks).

IN the *Journal of Comparative Neurology and Psychology* for October (xviii., No. 4) Mr. Judson Herrick discusses the morphological subdivision of the brain, and suggests a scheme of subdivision of the vertebrate nervous system which he thinks might be tentatively adopted as a terminology available for all vertebrates.

THE *Journal of Hygiene* for September (viii., No. 4) contains several important papers; among others, Mr. Currie discusses abnormal reactions to horse serum in the serum treatment of cerebro-spinal fever, Dr. Green discusses immunity against vaccinia in animals and the influence of temperature on calf vaccine, and Mr. Watson publishes a note on the variation of the rate of disinfection with change in the concentration of the disinfectant.

THE *Bio-Chemical Journal* for October (iii., No. 9) contains a paper by Dr. Owen Williams on the micro-chemical changes occurring in appendicitis. It would appear that in the course of the changes in the intestinal wall an abnormal condition with the formation of calcium soaps is induced. The calcium soaps are absorbed with difficulty, and tend to act as foreign bodies in the wall, and at times as a concretion in the lumen, of the appendix.

RATS and their parasites have assumed considerable importance in the dissemination of plague, also in trichinosis, and Mr. A. E. Shipley, F.R.S., in the *Journal of Economic Biology* (iii., No. 3, October) gives a long list of the ecto- and endo-parasites which infest these animals.

IN 1807 Dr. Francis Buchanan, author of the well-known "Journey through Mysore," was appointed to make a comprehensive survey of Bengal. After about 20,000*l*. had been expended on the work it was discontinued, and a portion of the MSS., now in the India Office Library, was published by Mr. M. Martin in 1838 under the title of "Eastern India." Even admitting its obvious shortcomings, the book has been of much value to later writers. Mr. H. MacPherson, Director of Land Records, Bengal, has now issued a pamphlet entitled "The Aboriginal Races of the Sonthal Parganas: a Plea for the Reprint of the Buchanan Manuscripts," in which he shows the value of the collection. If the Government of Bengal finds itself unable to re-print the collection *in extenso*, it may be hoped that it will at least publish the portions which Mr. Martin either abbreviated or omitted from his book.

ONE of the most primitive methods of chartography is that employed by the inhabitants of the Marshall Islands. Mr. T. A. Joyce, in the October number of *Man*, describes a chart of this class from the British Museum collection. It consists of a framework of sticks, those which are horizontal and vertical being intended as supports to the map, while the diagonal and curved rods represent the swells raised by the prevailing winds. At the intersections of the rods shells are fixed to denote the islands of the group. Comparison with a modern chart shows that the position of each island with reference to its neighbours is indicated with considerable accuracy. The distances from island to island are not so correctly defined; but this is a matter of minor importance, because the winds in these latitudes being constant at certain seasons the boat can be steered by the swells alone, and its position with reference to the islands can be determined by indications which the practised eye draws from cross-swells and the like. From the fact that the Ralic Archipelago is most accurately charted, it would appear that the maker of this map was a resident in one of the islands of this part of the group.

IN the October number of the *Reliquary* Mr. E. H. Goddard discusses the objects of the Bronze age which have been found in Wiltshire. It is remarkable that a

district which at the earlier period of the Bronze age was densely peopled should possess so few examples of the later period, when men no longer buried their weapons with the dead. The writer suggests as an explanation of this that Wiltshire possesses neither large rivers, like the Thames, nor turbaries and bogs, such as those of Somerset, Devon, and the north of England, situations where such relics are most abundantly found. The chalk downs of Wiltshire offered few opportunities for the loss of such things or for their preservation so late as our time. Even granting this, the absence of founders' hoards, except one from Donham, now in the Farnham Museum, remains unexplained. Socketed celts and palstaves are fairly numerous, but swords, except one doubtful example in the Devizes Museum, are conspicuously absent. One dagger found at Winterbourne Basset resembles those found in the Swiss lake-dwellings. The socketed sickle from Winterbourne Monkton is an unusual form of the implement, rare in any form in Great Britain, and almost unknown on the Continent, where sickles without sockets are the rule. In Ireland, however, they are more common. A socketed gouge, again, is an example of a type uncommon in England. It seems obvious that the conditions of the Wiltshire Bronze-age people differed in some respects from that of the race in other parts of this country, and the abnormal types to which Mr. Goddard directs attention may have been the result of some foreign influence or may have been imported. His article supplies good illustrations of these abnormal local implements.

THE present month has experienced very exceptional changes of temperature, although for the most part the weather has remained mild for the time of year. During the first week the thermometer stood high over the whole country, and in many parts of England the days were more like spring than late autumn. A decided change of temperature occurred about November 7, and for the two or three subsequent days the thermometer fell to an abnormally low reading. At Greenwich the first frost of the season was registered by the sheltered thermometer on November 10, and the thermometer fell to 22°, which is lower than any previous reading during the first half of November since 1841, whilst on the grass the exposed thermometer registered 9°. The weather report issued by the Meteorological Office for the week ending November 14 shows that similarly low readings occurred in other parts of the kingdom between November 8 and 11, the sheltered thermometer registering 16° in the east of Scotland, 17° in the Midland counties, and 18° in the east, south-east, and south-west of England. On the grass the lowest readings were 7° at Llangammarch Wells, 9° at Greenwich, 12° at West Linton, 13° at Birmingham, 14° at Newton Rigg and Kew, and 15° at Canterbury, Oxford, Buxton, and Dumfries. There was a rapid rise of temperature between the mornings of November 10 and 11, amounting to 30° at Oxford, 25° at Nottingham, and 23° at Bath. The subsequent weather has been very mild for the time of year.

THE monthly meteorological charts of the North Atlantic and Indian Oceans issued by the Meteorological Office, and the chart for the North Atlantic issued by the Deutsche Seewarte, for November, 1908, have been received. The charts issued by both countries contain practically similar useful information, and show on their face the normal values of the principal meteorological elements, the best routes for sailing vessels and steamships, the average limits of trade winds for the month in question, together with the latest reports of ice in the Atlantic and of the south-west monsoon in the Indian Ocean. On the backs of the charts are given average statistics of fog in the Atlantic, of ice in the Southern Ocean, and other information of importance to seamen. The charts are published during the month prior to that to which the data refer; they are compiled from all available sources at the disposal of the various meteorological and hydrographic offices, and deal with some thousands of observations. The labour involved is very onerous, but the value of the work, brought up to current time, cannot be over-stated.

AMONG several useful articles contained in the *U.S. Monthly Weather Review* for June last, recently received, we find a note by Prof. Cleveland Abbe suggesting the importance of establishing a graduate school of meteorology on the principle of that established by the Association of American Agricultural Colleges, in which lectures and experiments by specialists bring home to interested audiences the present state of agricultural knowledge. The third session of this school was held at Ithaca in July last; the "seminar" forms a predominating part of the work, in which the instructor undertakes to show students how important items of knowledge have been obtained, and replies to questions that may be put. Referring to meteorology, Prof. Abbe says:—"At present we rely too much on books and letters; we shall do better to get together, ask questions, try experiments, and compare notes." In this country a great step in this direction is made by the director of the Meteorological Office by continuing during the present winter season the series of meetings commenced in 1905 for the informal discussion of important contributions to meteorological literature, particularly those by colonial and foreign meteorologists. To these meetings contributors of observations to the office, and, so far as space permits, others known to be interested in meteorology, receive invitations to be present, and to take part in the discussions. We also note that in a recently published report of a departmental committee appointed by the Board of Agriculture the opinion is expressed that in agricultural institutions provision might well be made for instruction respecting the relations between meteorology and the crops.

THE October issue of the Journal of the Institution of Electrical Engineers contains a communication, made to the institution in May by Mr. G. F. Mansbridge, of the Post Office, on the manufacture of electrical condensers. Although other forms of condensers are mentioned, the chief interest of the communication centres round the rolled paper condenser, in the development of which Mr. Mansbridge has played so active a part. To it we owe the possibility of purchasing condensers for as many shillings to-day as we paid pounds a few years ago. They are made of paper, one side of which is coated with tin mud, which is then dried and burnished. Two sheets of this coated paper are rolled up together, with or without intervening layers of plain paper, and the roll impregnated with hot paraffin wax. A microfarad condenser constructed in this way, and tested by the direct deflection method, the voltage being applied one minute, shows an insulation resistance of 1700 megohms at 100 volts, 1500 at 500 volts, and 200 megohms at 1000 volts.

THE foundations of trigonometry form the subject of a paper by Dr. Arthur C. Lunn in the *Annals of Mathematics* (October). The author points out that in the existing literature of real analysis, the purely logical introduction of circular functions, apart from any appeal to geometrical setting to supply features of the proofs, is mainly accomplished in two ways, one by defining the sine and cosine in terms of their expansions in infinite series, the other by basing the definition on the differentiation formulæ

for the sine and cosine with the special conditions that $\sin 0 = 0$ and $\cos 0 = 1$. Dr. Lunn considers that a more elementary treatment can be obtained by starting from the following postulates, viz. the addition formula for the sines of numbers of the straight-angle set, the continuity of the sine and cosine, the assumptions that $\cos 90° = 0$ $\sin 90° = 1$, $\cos 180° = 1$, that $\cos x$ is not negative between 0 and 90°, and that if $\sin x/x$ has a limit when x vanishes that limit is unity. The last assumption is required to determine the unit of angular measurement.

In a paper communicated to the *Rivista marittima* for March last, and reprinted by the Officina poligrafica italiana of Rome (1908), Dr. Filippo Eredia discusses the prevailing winds in the Straits of Messina, and gives statistics of the observations made at various semaphore stations along the Italian and Sicilian coasts.

It was announced in last week's NATURE that on November 28 Mr. Thayer would give a demonstration at the Zoological Gardens of the obliterative effects of the costumes of animals. By an error, which we regret, the date was wrongly printed; it should have been November 18, and not November 28.

Messrs. Isenthal and Co., 85 Mortimer Street, London, W., have issued a list of precision instruments based on the resonance principle, containing information concerning the frequency and speed meters, as well as other instruments, constructed by them.

We have received from Prof. W. A. Herdman, F.R.S., a volume containing copies of four addresses delivered by him, in his capacity of president of the Linnean Society, at the anniversary meetings of the society in May of the years 1905–8. The subjects of the addresses were, in the successive years, Linnæus and artificial pearl formation, natural pearl formation, some fundamentals of sea-fisheries' research, and plankton studies in the Irish Sea.

OUR ASTRONOMICAL COLUMN.

Comet Morehouse, 1908c.—The remarkable changes which have been shown to have taken place in the extent and form of comet 1908c are well illustrated by a series of photographs taken by M. Quénisset at the Juvisy Observatory, and reproduced in the November number of the *Bulletin de la Société astronomique de France*.

Two photographs taken on September 30 with equal exposures showed changes in intensity, but were quite eclipsed by one taken the next night, October 1, between 10h. 48m. and 12h. 55m. The trail of a bright star interferes somewhat with the image of the comet's tail, but, despite this, it is seen that the tail has a large, bright condensation at some distance from the head. From the coma of the comet several narrow, straight streamers emerge, and then suddenly expand into a bright, nebulous mass which continues for some distance with a much greater breadth and diffuseness than the preceding part of the tail. It almost appears as though a tremendous activity of the head had emitted all this matter and had then subsided, leaving only the normal emission of material to form the straight, narrow streamers. This apparently fluctuating activity may easily be explained by assuming that, during its journey through space, the comet encounters meteor swarms of various densities.

These changes may be held to account for M. Bigourdan's widely published statement that, at about the time they were photographed, the comet lost its tail. The visual radiations certainly did decrease in intensity, but the photographic rays were not much fainter; M. Bigourdan's observations were visual.

Some of the photographs show a tail 17° long, that is, actually about twenty-seven million miles (43,000,000 km.), whilst the diameter of the nucleus is 10′ of arc, or actually about 290,000 miles (460,000 km.).

Numerous photographs, showing changes similar to those described above, have also been obtained at the Greenwich and Stonyhurst observatories.

Particulars of the more recent spectrum of the comet are published by MM. Deslandres and Bernard in No. 18 of the *Comptes rendus* (p. 774, November 2). The spectra were obtained with a specially designed spectrograph of 10 cm. aperture and 31 cm. focal length, fitted with an ultra-violet glass objective. A prism of the same glass, having an angle of 22°, was placed in front of the objective, and was, at times, supplemented by another of ordinary flint having an angle of 61°.

The spectra obtained differ on many points from those obtained earlier by Comte de la Baume Pluvinel and described in these columns. The present workers find that the ratio of ultra-violet to visual rays is abnormal, and that the continuous spectrum is very persistent both in the images of the head and of the tail. The hydrocarbon bands, usually a prominent feature of cometary spectra, especially in the green region, are apparently absent, whilst of the numerous cyanogen bands reported by de la Baume Pluvinel only the two first heads of the ultra-violet group, at λ 388, were photographed. The three strongest bands appear at about λ 456·1, λ 426·7, and λ 401·3, and are due to some unknown light-source. Many of the bands are double, and MM. Deslandres and Bernard suggest the possibility of this being due to the Zeeman or the Doppler effect, or, maybe, to some new phenomenon special to comets.

A New Spectroscopic Laboratory at Pasadena.—Owing to the difficulty of obtaining large supplies of electricity at the Mount Wilson Observatory, Prof. Hale has recently installed a new spectroscopic laboratory at Pasadena, where the laboratory researches necessary for the elucidation of present-day solar problems may be carried out. An illustrated description of the new laboratory appears in No. 3, vol. xxviii., of the *Astrophysical Journal* (p. 244, October).

The main instrument is a 30-feet spectrograph sunk in a waterproof well, 8 feet in diameter, in the concrete floor of the laboratory. The numerous pieces of apparatus for producing radiations are arranged around the well-head, the light being reflected on to the spectrograph slit by a plane mirror. Among the apparatus briefly described in the present note there is an electric furnace capable of withstanding pressures up to 200 atmospheres, and of giving temperatures up to 3000° C.; this is to be employed for studying the spectra of such refractory metals as vanadium and titanium at widely different temperatures. A transformer capable of producing voltages from 1000 to 64,000 has also been installed, whilst a complete outfit for the study of the Zeeman effect in various spectra is intended for the laboratory researches which will naturally follow Prof. Hale's recent and remarkable discoveries in the sun-spot spectrum.

A Large Group of Sun-spots.—Another large group of sun-spots, made up of a great number of smaller spots, has recently been seen on the solar disc. This group was first observed at South Kensington on November 6, and was for several days quite easily visible with the naked eye. Another extensive group was first seen, near the limb, on November 12, and was visible to the naked eye on November 17.

Biographical Memoir of Asaph Hall.—In April of this year Mr. G. W. Hill read before the National Academy of Sciences, Washington a biographical memoir of the late Prof. Asaph Hall giving an account of his life and work. This memoir now appears in vol. vi. of the Biographical Memoirs of the society (pp. 241–309), and is accompanied by a valuable bibliography of Prof. Hall's writings, published between 1858 and 1906, to the number of four hundred and eighty-six.

A Research on the Movement of Comet Wolf.—The results obtained from the first part of a research into the movement of comet Wolf, undertaken by M. Kamensky, of the Pulkowa Observatory, appear in No. 13 of the *Bulletin de l'Académie impériale des Sciences de St. Pétersbourg* (October, p. 1041). The present results consist of tables for the calculation of the eccentric anomaly, and they may be used in calculating the perturbations of Faye's and Tempel's comets also.

THE MANUFACTURE OF ARTIFICIAL GRAPHITE.

WITH the advance of electrochemistry it was found that electrodes of carbon were not so satisfactory as could be desired, because they disintegrated badly when employed in a great many of the electrochemical processes for which they were found to be practically the only substitute for the expensive platinum. Many attempts were therefore made to convert ordinary carbon into the more suitable modification—graphite—which possesses high conductivity and resistivity.

No very satisfactory method was devised, however, until Mr. Acheson succeeded in obtaining a very pure form accidentally when engaged in experiments upon the formation of silicon carbide, now known commercially as carborundum. Silicon carbide can be prepared by heating in the electric resistance furnace a mixture of silica and carbon, when the following reaction takes place:—

$$SiC_2+3C=SiC+2CO.$$

On one occasion, by the overheating of the furnace, he found that a large quantity of silicon carbide had been decomposed into carbon and silicon as follows:—

$$SiC=C+Si.$$

The silicon had actually been volatilised, and carbon in the form of graphite remained behind.

Silicon carbide is a magnificently crystalline product showing a splendid iridescence, and the graphite which was left behind had all the crystalline shape which the carbide originally had, but it no longer possessed iridescence, and in place of being next only in hardness to the diamond, was soft and friable, and had the familiar black appearance of graphite. Analysis showed it to be almost pure carbon, containing no more than 0·05 per cent. of impurities.

It might naturally be supposed that the purity of the final product would be directly affected by the purity of the starting material. This certainly would be so if it were simply a case of the high temperature of the furnace changing ordinary carbon into graphite; but as the reaction depends upon the formation of a carbide, which then at the great heat to which it is subjected loses one constituent by volatilisation, the other constituent remaining behind, and, furthermore, as at the temperature at which this reaction takes place all other metals are volatilised, or first converted into carbides and then volatilised, leaving the carbon, this is not so. In the preparation of graphite it is not necessary that sand in the proportions

$$SiO_2+3C=SiC+2CO$$

should be employed, because if the lower layers are converted into carbide volatilisation takes place. The vapourised silicon then passes through the next layer, and is converted into carbide; further volatilisation ensues, and the silicon passes through another layer, and so on progressively, until, finally, it passes out of the furnace as vapour.

The furnace is a long, oblong brick channel with electrodes at each end, which are connected together by means of a core made of granulated carbon. This core is surrounded by the mixture of sand and carbon, such as coke, from which the graphite is to be prepared. The furnace core is made of such dimensions that when the current is passed the temperature will be raised sufficiently high to convert the mixture surrounding it into carborundum, and then volatilise the silicon, leaving behind the graphite.

The carbon electrodes consist of twenty-five carbon rods, every rod being 80 cm. long and 10 cm. square. The internal part of the furnace is lined with silicon carbide, which protects the fire-bricks from the enormous operating heat. Generally, coal is employed as a raw material, being first broken to the size of peas; but as anthracite does not convey the current well, a conducting core of carbon rods is run through the centre of the furnace. When the furnace has been built up it is covered in with a mixture of sand and coke to prevent access of air. It is usually about 9 metres long, and the anthracite layer is 50 cm. by 35 cm. square. Such a furnace requires about 800 kilowatts to work it.

At the commencement of the operation the resistance is very high, therefore a high electrical pressure is required at the terminal electrodes. As the temperature rises and the core becomes graphitised, the resistance becomes less; consequently the voltage of the external circuit must be cut down. A pressure of about 200 volts is required at the commencement, but towards the end this is lowered to 75 volts. Shortly after the current is switched on, the volatile portions of the coal are driven off and burn with a characteristic yellow flame, which after a time becomes less, and its place is taken by the blue-coloured flame of carbon monoxide, because at this point the carbide commences to form. As the process continues the flame again becomes yellow, the carbide at this stage being decomposed. When the reduction is completed the flame is chiefly made up of burning volatilised metal, and shows a very fine absorption spectra. If a cold body is introduced into the flame it becomes covered with a felt-like coating of silicon dioxide.

The length of time required depends upon the purity of the graphite required. For most technical purposes it may contain up to 10 per cent. of ash. Further heating lowers the ash content, but, of course, as more energy is required, it increases the cost of the finished product.

Owing to the fact already mentioned, that much less than the theoretical amount of carbide-forming material need be added, Acheson finds that anthracite coal, which in its natural condition contains disseminated throughout its mass certain impurities, such as Fe_2O_3, SiO_2, Al_2O_3, &c., is particularly well adapted to produce graphite. That which contains 5·78 per cent. of impurities is especially suited for this purpose, and the graphite obtained from it contains only about 0·033 per cent. of ash. Other carbonaceous materials, such as brown coal, may be used, but, as a rule, the results are not so satisfactory.

It is not necessary that the carbide should be silicon carbide; other carbides, such as iron, appear to be of equal value in the formation of graphite. A spectrographic study of the flames produced in the operation always shows the presence of volatilised metals.

A particularly fine quality of graphite can be obtained from the coke left at the bottom of the stills used for cracking petroleum. This coke, known as petroleum coke, is honeycombed with small holes produced by the escaping gases, and the graphite obtained has exactly the same appearance as the original product, except that in place of the dull black of the coke it has the polished appearance characteristic of graphite.

For making electrodes, crucibles, motor brushes, and other articles of any particular shape, it is not necessary, as is the case with natural graphite, to grind up and then shape the articles with some suitable binding material; but by the Acheson process the articles are first made from some form of amorphous carbon, and afterwards converted directly into graphite. For example, lamp-black, powdered wood charcoal, or coke is mixed with a metal, its oxide or salt, which is capable of forming a carbide; the mixture is then moistened with water containing a little sugar—molasses or other binding material—made into a paste, and formed into any desired shape. It is then placed in the electric furnace, embedded in broken carbon, and covered over with amorphous carborundum to prevent loss of heat. The dimensions of the furnace are so arranged that when the current is passed the temperature is raised sufficiently high to graphitise a portion of the carbon; the furnace then becomes more conducting, and the pressure at the terminals can be lowered. As an example of the proportions of carbon and oxide used, the following has been found satisfactory for the formation of motor brushes:—ninety-seven parts finely powdered wood charcoal and three parts of iron oxide mixed into a paste and formed into the desired shape. If the electrodes are separated about 5 metres, the space between being filled with the articles to be graphitised and packed with carbon, an initial E.M.F. of 150 volts causes a current of 300 amperes. As the carbon and articles become graphitised the E.M.F. drops, until with a pressure of 100 volts a current of 7000 amperes is passing.

Acheson finds that it is not always desirable to convert the whole of the articles into graphite, but that if the operation is stopped when a portion is still ungraphitised they are stronger and less liable to fracture than when they consist of pure graphite.

It has already been mentioned that graphite of any desired purity can be obtained by this process, it simply being a question of how long the product is heated in the furnace. When it is to be ground and used as a lubricant it is necessary to make it of a higher degree of purity than when required for many other purposes; but, however pure the graphite, there are certain difficulties in employing it as a lubricant mixed with oil or water, owing to its precipitating out very shortly after being mixed with them. Although many attempts have been made to get over this difficulty, it is only quite recently that Acheson has been successful in doing so. In 1901, when experimenting upon the manufacture of crucibles, he found some difficulty in obtaining clay which had good binding qualities. He therefore commenced the study of clays which are used in the manufacture of crucibles. It was noticed that American crucible makers imported the clay from Germany, because, although the clay has practically the same chemical constitution as the American product, it has a greater tensile strength and is more plastic. Acheson then noticed that clays found at or near to the place at which the felspar rocks are decomposed are not so plastic or strong as when obtained at a distance from their source of origin. It occurred to him that this might be due to their containing vegetable or organic extract matter.

International Acheson Graphite Co., Niagara Falls, N.Y., U.S.A.

Experiments were therefore undertaken upon the action of vegetable extract matter, such as tannin and plant extracts, upon various clays. Remarkable results were obtained, it being found that a weak and only moderately plastic clay, after treatment with a dilute solution of tannic acid or extract of straw, increased in plasticity and became much stronger. In some cases the increased strength was as much as 300 per cent., and only 60 per cent. as much water was required to produce a given degree of fluidity. It remained suspended in water, and would pass through a filter paper. Clay thus treated Acheson called "Egyptianised," because the "Children of Israel" used straw in making bricks.

Now as clay so treated would remain suspended in water, it occurred to Acheson that perhaps the fine, unctuous graphite which he succeeded in directly manufacturing in the electric furnace in 1906 would also remain suspended in water if thus treated.

When disintegrated, graphite is treated with water containing tannin, the weight of which was from 3 per cent. to 6 per cent. of the graphite employed. The graphite remains suspended in the water indefinitely, and passes through a fine filter paper; it is therefore in a semi-colloidal condition. Graphite so treated Acheson calls "*deflocculated*." To cause complete deflocculation and the suspension of the whole of the graphite requires prolonged mastication in the form of a paste with water and tannin, and after this mastication it is improved by diluting with considerable water and allowing to remain some weeks, with occasional stirring. The addition of a very small quantity of hydrochloric acid causes flocculation and precipitation.

The graphite, even after it has been flocculated, is in so fine a state of division that when dried by evaporation *en masse* it forms a hard cake. It is self-binding, like clay, and when dried in the sun is like a black clod of clay.

This deflocculated graphite is a splendid lubricator, and may be used in place of oil. It was tested on a shaft measuring 25/16 inches in diameter, and running at 3000 revolutions per minute in a bearing 10 inches long. On the same shaft a similar bearing was lubricated with oil, and this ran much the warmer of the two. If water alone is used for lubricating, rusting ensues; no rusting takes place with deflocculated graphite. Deflocculated graphite can also be suspended in the dehydrated state in oil. The two products come on the market as "aquadag" and "oildag" (d-a-g = deflocculated Acheson graphite).

Aquadag has been found very satisfactory as a cutting compound in screw-cutting. It will be readily understood that, while preventing rust, the high specific heat of the water permits high speed of the machinery, and therefore increased output. One disadvantage of aquadag is the rapid evaporation of the water; consequently, for general lubricating purposes, oildag is of more value. For automobile lubrication, for example, oildag is stated to have proved much more efficient than oil without graphite.

F. M. P.

THE FAUNA OF THE MAGELLAN REGION.[1]

IN 1892–3 Dr. W. Michaelsen conducted a zoological collecting expedition to the south end of South America, and was remarkably successful as regards booty. Descriptions of his collections began to appear in 1896, and they are now gathered together in three substantial volumes, each of several hundred pages. Dr. Michaelsen gives a lively account of his journeyings, and Prof. Dr. G. Pfeffer, of Hamburg, who persuaded some of his enlightened fellow-citizens to subsidise the expedition, refers briefly to the general bearing of the various contributions. It seems to us a matter for regret that there is no adequate summation of the results of the expedition, though we do not know what more Dr. Pfeffer could have done within the limits allotted to him. It is certainly

1 "Ergebnisse der Hamburger Magalhaensischen Sammelreise 1892–93. Herausgegeben vom Naturhistorischen Museum zu Hamburg. Bd. i., Allgemeines, Chordonier. Echinodermen, und Cœlenteraten. Bd. ii., Arthropoden. Bd. iii., Bryozoen und Würmer. Not continuously paged; numerous plates. (Hamburg: L. Friederichsen and Co., 1896–1907.)

very difficult to deal with a huge bundle of memoirs, by about forty different authorities, and bearing diverse dates from 1806 to 1907. We cannot do more than give a general indication of the contents of these volumes.

Dr. Paul Matschie reports on eight species of mammals, including a new mouse (*Acodon michaelseni*, n.sp.), and refers to a number of remarkable facts, such as the occurrence in the sub-Antarctic region of a cat (*Felis pajeros*) which closely resembles the Manol-cat of Central Asia. G. H. Martens discusses the birds, of which forty-two species were collected. He notes that 299 species (in 176 genera) are known to occur in the Antarctic and notial regions (south of a line between 42° and 43° S.), that of these 192 are confined to the western hemisphere and fifty-six to the eastern, while forty-eight are circumpolar. It is pointed out that about a third of the families of birds are represented in the southern polar region. We may direct attention to the statement that the Arctic tern is found as far south as 66°. Dr. Franz Werner describes two new iguanids from Chili—species of the genus Liolæmus—and a new batrachian, *Leptodactylus kreffti*, also Chilian. Prof. Einar Lönnberg deals with forty-six species of fishes, including *Etmopterus paessleri*, a new dog-fish. Prof. Michaelsen reports on the tunicates, describing some new forms, discussing the classification of Polyzoidæ, and showing that Paramolgula, Agnesia, Boltenia, and Synoicum are good instances of bipolar genera. The typical form of the pelagic *Fritillaria borealis* is found in the two polar regions, while other forms (*sargassi* and *intermedia*) are found in the tropics.

Prof. H. Ludwig makes an interesting comparison of Arctic and Antarctic holothurians. No Antarctic species occurs in the Arctic fauna; ten genera are represented at both poles; nine genera represented in the south are absent from the north; six genera represented in the north are absent from the south; of the ten genera represented at both poles, none is exclusively polar; two genera—Pseudopsolus and Theelia—are exclusively Antarctic; four genera—Eupyrgus, Trochoderma, Myriotrochus, and Acanthotrochus—are exclusively Arctic. It comes to this, that there is no special resemblance between Antarctic and Arctic holothurians; on the contrary, there is *great dissimilarity*. It is pointed out that ten forms showing "parental care" are now known, that six of these are peculiar to the Antarctic, and that each of the six has solved the problem in a fashion of its own. There is hermaphroditism in *Cucumaria crocea* and *Pseudopsolus macquariensis*, while in two synaptids (*Chiridota pisanii* and *Ch. contorta*) the sexes are separate. Dr. M. Meissner describes a new echinus from Gough Island, and takes a survey of the southern forms. He notes some illusory suggestions of bipolarity which he corrects later on; the fact is that there is little in common between north and south. Only one species of Antedon (*A. rhomboidea*) was obtained from the Magellan region, but Prof. Ludwig takes a survey of the known southern forms. He finds that the species of Antedon are in a general way like the northern species, but there is no bipolar species, and there are no northern counterparts of *Thaumatocrinus renovatus*, *Promachocrinus kerguelensis*, and *P. abyssorum*. In his report on the ophiuroids, Prof. Ludwig notes that although six genera occur in both polar regions, there is no bipolar species. Meissner discusses the asteroids, and notes that although fifteen genera are represented in both polar regions, there is no bipolar species. Dr. Walther May discusses the twenty-two species of alcyonarians from the Magellan region, including the three new species *Alcyonium paessleri*, *Metalcyonium patagonicum*, and *Virgularia kophameli*. Dr. Carlgren reports on the Zoantharia, describing many new species and establishing a number of new genera, Condylanthus among Antheadæ, Isotealia, a Bunodid, Parantheoides, one of the Paractidæ. There is no clear case of bipolarity of species. An interesting fresh discovery is that of numerous brood-pouches (ectodermic invaginations of the body-wall) in *Condylactis georgiana*, the first case recorded among Antarctic Actiniaria.

The reports on Arthropoda make up a thick volume. In his account of the Hemiptera, G. Breddin establishes a new family to receive a somewhat isolated type, Peloridium; H. Schouteden describes two new aphids; Prof. A. Forel discusses three new ants, which are the most southerly representatives of their race as yet recorded; E. H. Rübsaamen reports on a remarkable new Pteromalid (*Aditrochus fagicolus*, n.g. et sp.), peculiar in structure and unique in making Cynipid-like galls on the leaves of the Antarctic beech, whereas all other gall-making Pteromalids, so far as is known, attack monocotyledons (orchids and grasses). Prof. H. Kolbe uses the beetles to support the theory of a connection through the Antarctic continent between the south of South America (Archiplata) and Australia (including New Zealand). Dr. O. Staudinger discusses the Lepidoptera of the Magellan region, and describes more than a score of new species. The small collections of Trichoptera and Ephemeridæ are reported on by G. Ulmer; Prof. Fr. Klapálek describes a few new Plecoptera; Dr. F. Ris has based his report on Odonata on more material than the collection afforded, and he has been able to show the striking contrast between the Atlantic and the Pacific sides as regards their dragon-flies. Dr. C. Schaffer had a large collection of Apterygota to deal with (including twenty-two new species), and he has established five new genera. He directs attention to the presence of a large number of European forms, *e.g.* species of Achorutes, in South America.

E. Simon deals with the spiders, many of which are new. He points out that the Clubionæ and Agelenidæ form more than half the whole arachnoid fauna in the Magellan region. In connection with *Bigois antarctica*, n.sp., he refers to the occurrence of the only other species, *B. pupa*, in the Philippines, "one of the strangest facts of geographical relations, of which no adequate explanation can be suggested at present." He also reports on a couple of scorpions, a book-scorpion, and two Opiliones. The Gonyleptidæ, or Opiliones Laniatores, are dealt with by W. Sörensen, and the mites by Prof. P. Kramer, who remarks on the absence of any characteristic Magellan genera. Dr. Carl Graf Attems reports on three myriopods—apparently the first to be recorded from the Magellan region. One of them is the widespread European and North American *Scolopendrella immaculata*; the second is a new species of Scolioplanes a genus the representatives of which are known from Europe and the East Indies; the third is nearly allied to the European and north African species of Schendyla, but is made the type of a new subgenus, Schendyloides. It is thus evident that, so far as may be judged from these three species, the Magellan myriopods have close affinities with Palæarctic forms.

Mr. T. V. Hodgson describes three new species of pycnogonids belonging to the genera Nymphon, Tanystylum, Colossendeis; Dr. Carl Zimmer deals with a new species of Neomysis and six new Cumacea. Dr. W. Weltner discusses the Cirripedia, and compares the Arctic and Antarctic forms, showing that the seven genera and the four species which are represented both in the north and the south are cosmopolitan in their distribution. Of the fresh-water ostracods described by Dr. W. Vávra, three are European and cosmopolitan, and five new species belong to widely distributed genera. The same authority deals with the fresh-water Cladocera, of which four are new. Al. Mrázek discusses the fresh-water copepods, and lays emphasis on the distinctiveness of the southern Centropagidæ, among which Parabroteas, Lovenula, and the genera centred around Boeckella are especially characteristic.

L. Calvet reports on sixty-one species of marine Bryozoa, of which three are cosmopolitan, seven occur also in Arctic seas, and three others are sub-Arctic. Of the thirty-five genera represented, no fewer than twenty-five have Arctic as well as sub-Antarctic species. Thus, as regards *genera*, there is considerable resemblance between the north and the south, but a similar resemblance exists between the tropical littoral genera and those of the north or south. There is not much resemblance between north and south as regards *species* of Bryozoa, and it cannot be said that there are in the deep sea any connecting links between the Arctic and Antarctic contingents.

Dr. W. Fischer's short report on four Gephyrea is very interesting, for he shows that the Antarctic forms of Phascolosoma are simply varieties of the Arctic *Phascolosoma margaritaceum*, Sars, that *Priapulus caudatus* is

also bipolar, and that the southern *Echiurus chilensis* and *Priapuloides australis* have their counterparts in the northern *E. unicinctus* and *P. typicus*. Prof. R. Blanchard describes six new species of leeches belonging to the genera Trachelobdella (1), Helobdella (4), and Semiscolex (1). Mr. Frank E. Beddard deals with a large number of new Oligochæta. Thus he establishes a new genus of Limicolæ, Hesperodrilus, with four species, and among Terricolæ he describes thirteen new species of Acanthodrilus and eight of Microscolex. He regards the south of South America as the headquarters of these two genera, while the Geoscolecidæ and the genera Kerria and Ocnerodrilus are as distinctively northern. The collection included eight Lumbricidæ, which are all European species, and probably imported. Dr. Michaelsen also makes a report on the Terricolæ, adding some new forms and adjusting the names of others in accordance with his system of classification. Dr. H. Ude deals with the Enchytræidæ, and points out that the genera represented in the sub-Antarctic region, *e.g.* Enchytræus, Pachydrilus, and Marionina, are familiar European or even boreal genera. This indicates the world-wide distribution of an ancient fresh-water fauna. But, curiously enough, the genus Mesenchytræus is not represented at all in the Antarctic region.

Prof. Ernst Ehlers reports on the Magellan Polychæta—eighty-five species (thirty-six new) in fifty-five genera—and gives an interesting description of the general features of the polychæt fauna, such as the strong representation of Syllidæ and Phyllodocidæ. The following species occur in the boreal and notial regions, but not in the intermediate tropical and subtropical seas: *Nephthys longisetosa*, *Glycera americana*, *Scolecolepis vulgaris*, *Arenicola assimilis*, and *Notomastus latericeus*. How this "bipolarity" is to be accounted for Prof. Ehlers does not say.

Dr. von Linstow has some very remarkable facts to relate regarding nematodes. Thus *Ascaris osculata* of northern Fissipedia occurs also in exclusively Antarctic forms, and *Ascaris adunca* occurs in northern and southern fishes the habitats of which in no way overlap. From cases like these, and from the character of the free-living nematodes, von Linstow argues that in past ages the conditions of life and evolution must have been more uniform over the earth, and the occurrence of types much more widespread. Dr. O. Steinhaus points out that four species of Chætognatha are common to the far north and the far south. As to nemerteans, Prof. O. Bürger directs attention to the complete absence of Protonemertini from southern waters, and to the occurrence of *Carinoma patagonica* in the Straits of Magellan its only known congener being the rare *C. armandi* of the British coast. He thinks that the resemblance of the boreal and notial nemerteans is undeniable, so long as we fix our attention on genera.

Prof. Lönnberg remarks on the close resemblance between three southern cestodes and Scandinavian species. It is the similarity of host that counts. The northern host of *Bothridiotaenia erostris* is a gull or a fulmar; the southern host of the same is a penguin. Prof. Max Braun establishes a new genus of trematode, Lophocotyle, which ranks among the Monocotylidæ; Dr. Rudolf von Ritter-Záhony establishes two new genera of polyclads; and Prof. L. Böhmig describes three new rhabdocœlids and five new triclads.

It should be noted that most of the authors have increased the value of their contributions by including in their survey all the forms recorded from the Magellan region. As regards the question of "bipolar" distribution, to which most of them refer, the impression left on a reader's mind is that it is very difficult to generalise. It appears that the state of affairs differs in regard to different sets of animals. In some cases, *e.g.* holothurians, the dissimilarity of boreal and notial forms is more striking than the resemblance; in other cases, *e.g.* Bryozoa, there is a marked resemblance as to the genera represented at the two poles, but this does not extend to any identity of species; in a few cases, *e.g.* Gephyrea, the same species occur north and south, but some of the instances of this kind have to be discounted when the species in question (*e.g.* of Cirripedia) are cosmopolitan.

BOTANY AT THE BRITISH ASSOCIATION.

THE proceedings of Section K at Dublin, under the presidency of Dr. F. F. Blackman, were rather above than below the average standard of quality, and were characterised by more homogeneity than is usually the case, a large proportion of the papers dealing with certain aspects of physiological botany. Several of these dealt with those fields of investigation in which progress at present consists in the application of physico-chemical principles and quantitative methods to the experimental analysis of complex physiological phenomena into their component processes and factors.

The presidential address (NATURE, October 1, vol. lxxviii., p. 556), which was entitled "The Manifestations of the Principles of Chemical Mechanics in the Living Plant," dealt with this aspect of physiology, and urged the view that in some cases the internal metabolic changes of the organism which follow external changes should be regarded, not as reactions of protoplasm to stimulation, but as inevitable alterations of metabolic reaction-velocity.

Physiological Papers.

The death of individual cells as brought about by chemical poisons or high temperatures is a complex phenomenon, the experimental quantitative investigation of which leads to important biological conceptions. Two papers were communicated on this subject after the delivery of the presidential address. The first, by Miss Harriette Chick, dealt with the death-rate of bacteria under the action of disinfectants. When a crowd of similar bacteria are treated with any disinfectant they die off at such a rate that the "number surviving" after successive intervals of time fall into a logarithmic curve. The process of killing is thus continuous, and there is no definite time of exposure which can be said to be fatal. The killing goes on in a way that recalls the progress of a monomolecular reaction according to the "law of mass." It is shown that the different times of resistance of the bacteria are not due to permanent differences between the individuals, but that these differences are temporary and possibly phasic. Viewed in this way, the rate of killing is a phenomenon of reaction-velocity, and it is found that increase of temperature accelerates the reaction-velocity of disinfection just as it does that of a chemical reaction.

This paper was followed by one by Miss Nora Darwin and Dr. F. F. Blackman, dealing with the death-rate of cells of higher plants in fatal conditions. When it is realised that bacteria die off logarithmically under uniform unfavourable conditions, it becomes at once interesting to determine whether the cells of a tissue of a higher plant die in the same independent way, or whether their closer protoplasmic connection leads to their behaving all alike. Experiments on this point are being carried out with strips of potato, fuchsia stamens, and other organs, using the shortening of the tissue resulting from loss of cell-turgor on death as an indication of the progress of the death-rate. An optical lever was used to record the shortening, and submersion in hot water as the fatal condition. The cells of the tissue appear to behave like a number of bacteria, and to die off progressively and logarithmically, but this interpretation has yet to be firmly established. Seeds submerged in water at 42° C. to 50° C. exhibit clearly a logarithmic death-rate.

Other physiological papers were communicated on Thursday by Prof. H. H. Dixon, on the influence of living cells on the transpiration current, and by Prof. Bose, on the mechanical and electrical responses of plants. Prof. Dixon described experiments to show that there is no evidence of vital activity as a contributory factor in raising the transpiration current in a branch. The rate of transmission of water in a branch from above downwards was found to be the same before and after killing by steam or picric acid. The fading of leaves on a steam-killed branch is shown to be directly due to a poison liberated into the transpiration current by the dead cells, and is not to be taken as evidence that some preexisting vital raising force has been extinguished by the killing.

Prof. Bose gave a summary of his views on plant-responses as expounded in his recent books. His paper was

illustrated by experiments with the ingenious apparatus devised by him for investigating the mechanical and electrical responses universally exhibited by plants on stimulation.

Friday morning was occupied with a series of five papers on photosynthesis by workers at Cambridge. The president gave an introductory paper on photochemical action in the test-tube and the leaf, which consisted of a short account of the quantitative laws governing such chemical changes *in vitro*, followed by an inquiry as to how far the conditions under which photolysis of CO_2 takes place in the leaf would allow these laws to come into action.

Mr. Thoday then read a paper on increase in dry weight as a measure of assimilation. This is the first critical examination of Sachs's classical method, with the object of directly determining the nature and magnitude of possible errors that the procedure involves. Many investigators have used it confidingly, but recently it has been suggested that the method gives uniformly too high results, possibly due to fixation of water in the cell during insolation, in addition to the formation of carbohydrates. Mr. Thoday has proved that there is no such fixation of water by finding that organic analysis of the increased carbon content makes it clear that practically the whole increase of dry weight may be reckoned as carbohydrate. Further, it is shown that the excessively high values sometimes obtained are really due to another cause, namely, to shrinkage of the leaf-surface by transpiration. Records were exhibited showing that an attacked leaf of sun-flower fluctuates in area to the extent of 5 per cent. in the course of a few hours, shrinking during periods of insolation, recovering when passing clouds check the rate of transpiration.

Following this Mr. A. M. Smith gave an account of his work on the factors influencing photosynthesis in water plants. This work was carried out with an apparatus designed by Dr. F. F. Blackman, in which a complete knowledge of the whole amount of assimilation is obtained by combining an analysis of the bubbles given off by the assimilating plant with an estimation of the diminution in CO_2 content of the water flowing over the plant.

The magnitude of assimilation in relation to the amount of dissolved CO_2 in the surrounding water was first investigated, and it was found that the assimilation varied proportionally with the CO_2 supply until the limit set by the temperature or light intensity (in the particular conditions of experiment) was reached. No indication of an optimum CO_2 content was found, and assimilation only begins to be depressed when the water is one-third saturated with CO_2.

It was further shown that aquatic flowering plants possessing an "internal atmosphere" can work up a greater proportion of the CO_2 supply than an aquatic moss (Fontinalis) which has no "internal atmosphere."

Mr. Parkin communicated a paper on the carbohydrates of the snowdrop leaf and their bearing on the first sugar of photosynthesis. The work of Brown and Morris in 1893 on the carbohydrates of the leaf of Tropæolum brought forward the new view that sucrose rather than glucose plays the important part in the "up-grade" sugars of the foliage leaf. In that leaf the sugar metabolism is complicated by the fact that starch is abundantly present, and from it glucose could arise by hydrolysis. In the snowdrop starch never occurs, so that this leaf is a simpler case for investigation. Sucrose, levulose, and dextrose were found in abundance, and the fluctuations in their relative amounts followed. With increasing assimilation the sucrose steadily increases, while the amounts of levulose and dextrose remain fairly constant. This is interpreted as favouring the view that sucrose is directly formed in photosynthesis and that the hexoses are formed from it by hydrolysis.

This view falls more into line with the conception that the first sugar is split off from a complex protein aggregate than with Baeyer's view of progressive condensation from formaldehyde.

A paper by Mr. J. M. F. Drummond on the time factor in assimilation was communicated by the president. Experiments were made on the amount of assimilation taking place in cut-off leaves in a chamber lighted by artificial light continuously for several days. After a time the power of assimilation diminishes, and the object of the work was to find the precise explanation of this result. It was proved that part of this diminution is due to accumulation of the products of assimilation in the leaf, and that the power of assimilation is regained after the leaf has been kept in the dark for a period and has diminished its carbohydrate stores by vigorous respiration. A second cause of diminished assimilation is the shutting of the stomata by the high general turgor of the epidermis brought about by the high sugar content of the sap. This factor can be recognised by the increased assimilation which immediately follows incisions into the leaf or the application of dry air. The effect of stomatal closure can be overcome by increasing the CO_2 supply in the air current through the chamber.

Ecological Papers.

Friday afternoon was occupied by two papers on the woodlands of England, by Mr. Tansley and Dr. Moss respectively. Mr. Tansley devoted the first portion of his paper to an attempt to show that the great majority of English woodlands are actually derived from natural woods, and retain enough of their primitive character to be treated as natural or semi-natural plant associations. He went on to distinguish four great types of natural English woodland, determined by soil characters—the oak type, the oak-birch-heath type, the ash type, and the beech type—and to explain the distribution, character, composition, and principal subtypes of each of these.

Dr. Moss, agreeing with Mr. Tansley's main scheme of classification, dealt especially with the woods of the Pennines, on which he distinguished upland oak (*Quercus sessiliflora*) and birch woods, with transitions between them. These, which occur on siliceous soils, he regarded as differentiations of the oak-birch-heath type, according to the factor of altitude. Opposed to these, and of essentially different character, are the woods belonging to the ash type, which occur on the mountain limestone of that region. The woods of the lowlands of northern England agree ecologically with those of the south, but the beech type is entirely absent.

Prof. R. H. Yapp gave an account of his observations on the evaporating power of the air in different strata of the marsh formation of Wicken Fen. The average evaporation in the free air above the tallest plants is about 1·7 times that in the layer immediately below the tops of the tallest plants, and 6·8 times that in a stratum 18 inches below the surface of the vegetation and just above the soil-level.

Morphological and Palaeobotanical Papers.

On Tuesday morning Mr. W. C. Worsdell read a paper on the origin of dicotyledons, in which he based his view of the phylogeny of this group on the doctrine of "anaphytosis," or the building up of the plant body from a colony of distinct individuals or "phytons," budding one from another as the stem grows in length. He held that the facts of embryogeny in vascular plants are entirely opposed to the ordinary view that the plant primarily consists of a single shoot bearing leaves as lateral appendages. The primary individual of the colony of phytons, as represented by the embryo of the higher plant, is phylogenetically derived from the bryophytic sporogonium, of which the capsule, seta, and foot correspond with the primary phyllome, caulome, and root of the vascular plant. The facts of embryonic segmentation and the dominance of the cotyledonary organs were cited as being opposed to the monaxial view, in which the stem is regarded as the dominant organ and the leaves as appendages. From this position the author deduced the primitiveness of the monocotyledonous type with its terminal cotyledon, which must have preceded the dicotyledonous type, in opposition to Miss Sargant's theory of the derivation of the monocotyledonous from the dicotyledonous type by fusion of the two cotyledons. Anatomical evidence was adduced to show that the scattered bundle arrangement of monocotyledons is primitive, and that vestiges of this arrangement are found in many dicotyledons. The absence of anatomical evidence in seedlings pointing to such a conclusion was attributed to space-relationships. Finally, pleiomery of the flower was recognised as primitive, and the prevailing trimery of monocotyledons as reduced from such a condition. Mr. Worsdell's views were criticised, mainly from a hostile standpoint,

by Miss E. N. Thomas, Mr. Parkin, Prof. Bower, and others.

Prof. H. H. W. Pearson, of Cape Town, contributed a note on the morphology of endosperm, in which he described the development of the endosperm in Welwitschia and discussed the homologies of this tissue with the endosperm in the angiospermous embryo-sac. At an early stage of development of the endosperm of Welwitschia all the cells are multinucleate, while at a later stage each cell has a single nucleus (Pearson, Phil. Trans. R. Soc., 1906). An examination of material collected in 1907 showed that the latter condition is brought about by the fusion of nuclei in the cells of the young endosperm. The original nucleus of an embryo-sac produces by repeated division rather more than 1000 nuclei; the sac then elongates, and the free nuclei are re-distributed, with the result that two regions are differentiated, a micropylar region with scattered nuclei and a lower region with more crowded nuclei. The sac is next divided into compartments, those at the micropylar end having two to six, and the others usually twelve or more nuclei. The compartments containing more than six nuclei are converted by nuclear fusion into uninucleate cells; the nuclei in the micropylar compartments remain free, and the wall of each "cell" grows upwards into an embryo-sac tube ("prothallial tube"), into which pass the nuclei and cytoplasm; these nuclei are functional gametes. The conclusion is that the endosperm of Welwitschia represents a new organism, which it is proposed to call the *trophophyte*, intercalated in the life-cycle, belonging neither to the sporophyte nor to the gametophyte. It is the opinion of the author that the trophophyte of Welwitschia is phylogenetically related to the endosperm of angiosperms.

On Tuesday Prof. Weiss read a paper on the primary wood of Lepidodendron and Stigmaria. A new Stigmaria was described in which the xylem of the stele consists of a central strand of long, narrow, protoxylem-like elements mixed with parenchyma, surrounded by normal centrifugal secondary wood. This type of stele was compared with that of *Selaginella spinosa* and of the "hypocotyl" of *S. Kraussiana*, and also with that of *Lepidodendron selaginoides*. The general relations of the steles of the Lepidodendreæ were discussed.

Mr. H. H. Thomas communicated a paper by Mr. Newell Arber and himself on the structure of *Sigillaria scutellata*, Brongn. This was the first full account of the structure of a Sigillarian stem of the Rhytidolepis type. The primary xylem of the stele forms a continuous ring of scalariform tracheids surrounding the medulla. Secondary xylem is also present. The characteristic external ribs are really formed of cortical tissue, not of fused leaf-bases, and are largely composed of phelloderm. A ligule in its pit was demonstrated for the first time. The leaf-trace in the leaf-base contains a double xylem strand with widely separated xylem groups of the Sigillariopsis type.

Mrs. D. H. Scott described some curious spindle-shaped bodies in Burntisland material, naming them *Bensonites fusiformis*. She inclined to the view that they are glandular structures belonging to *Stauropteris burntislandica*, with which they are associated. A sporangium of this species was found to contain germinating spores.

Miscellaneous Papers.

On Thursday Colonel H. E. Rawson contributed a striking account of colour changes in flowers produced by controlling insolation. He has found that by shading various plants (such as nasturtiums) from the direct rays of the sun during certain hours of the day the colours of the flowers produced are changed from scarlet and orange to mauve, and in other cases to deep carmine. The variations thus produced breed true, both from cuttings and seeds. In other instances bronze, old-gold, rose-salmon, and sallow flesh-coloured flowers have been produced by similar means. Dahlias and other flowers appear to be as susceptible as nasturtiums to this treatment.

Mr. W. L. Balls contributed two papers on the mechanism of mitosis and on the natural crossing of the cotton plant.

Mrs. D. H. Scott read a paper on the contractile roots of the aroid *Sauromatum guttatum*, in which she showed that if the tuber of this plant is planted on the surface of the soil it throws out leaves and subsequently disappears below the surface, and in two months' time is found at a depth of 6 inches. The descent is caused by the thick fleshy roots sent out from the upper surface of the tuber, which firmly attach themselves to various objects in the soil, and then contract to about half their original length, pulling the tuber down. Later on these contractile roots are cut off from the tuber by regular alseris layers. If the tuber is replaced on the surface it sends out a fresh set of contractile roots, and is again pulled down to the normal depth.

Mr. M. Wilson contributed notes on the life-history of *Haematococcus lacustris*, in which he described the results of various culture experiments on this species. The red cells were found to be produced in starved liquid cultures, and to be alone capable of withstanding the effects of drying. Dr. Lotsy contributed an interesting paper on the segregation of characters of a perfectly fertile species-hybrid.

Mr. Harold Wager made a contribution on the optical behaviour of the epidermal cells of leaves. He discussed Haberlandt's theory that the convergence of light rays brought about by the lens structure formed by the papillæ of the epidermal cells of many leaves brings about a differential illumination of the protoplasm on the basal wall, and thus creates a stimulus which results in the appropriate orientation of the leaf to the incident light. It was pointed out that the objection to this theory, based on the absence of epidermal lens papillæ from heliotropically sensitive grass-seedlings, may be met by the fact that the epidermal cells of the first (sheathing) leaf and of the young leaves enclosed in the sheath do actually cause convergence of light rays in spite of the absence of papillæ. In the author's opinion too little attention has been paid to the view that the lens structures in question may be concerned with the more efficient illumination of the chloroplasts. It is also possible that the structures in question are accidental, and not to be regarded as adaptations, since they also occur on the lower epidermis of various leaves, on the epidermis of some petals, and in the fungus Russula. Mr. Wager exhibited well-defined photographs of various objects made through these epidermal lenses.

Monday morning was devoted to a joint discussion with Section D on the determination of sex. This is reported in the article on "Zoology at the British Association" (NATURE, October 22, vol. lxxviii., p. 647).

Members of Section K were fortunate in being able to meet in Prof. H. H. Dixon's beautiful new botanical institute at Trinity College, where everything was arranged for their comfort and convenience.

The sectional excursion was held on the Saturday to the Murrough of Wicklow, a long stretch of shingle beach backed by marsh, under the leadership of Mr. R. Lloyd Praeger.

MR. LLOYD GEORGE ON THE ENDOWMENT OF UNIVERSITIES.

ON November 13 the University of Wales conferred the degree of Doctor of Laws, *honoris causa*, on Mr. Lloyd George. At the complimentary banquet given by the University College of North Wales, Lord Kenyon announced a donation of 1000*l*. from Sir Herbert Roberts to the college building fund. In replying to the toast in his honour, Dr. Lloyd George alluded to the sacrifices the Welsh people have made in building up their system of higher education, and pointed out that the University of Wales has entirely altered the status of the Welsh people. It would be the worst thing for the Government to take the task entirely out of their hands, but the time has arrived for the Government to render further assistance, and one great need of the colleges is a very commonplace one—cash. Further assistance of a substantial character would make a vast difference in the immediate prospects. One of the ablest committees has investigated the claims of the Welsh colleges, and the conclusions arrived at are very favourable. The committee indicated several directions in which more could be done if the colleges had more money.

Dr. Lloyd George had to consider the report of the committee, and it was his duty as Chancellor of the

Exchequer, viewing the circumstances of Wales, Ireland, England, and Scotland, to make a very substantial contribution to the funds of the University. The building fund of the college at Bangor has already received a Treasury grant (20,000*l.*), and it is the duty of the people of North Wales to complete that work; but in regard to what has been said about raising the status and improving the staff and equipment of the college, Dr. Lloyd George fully approved of every word. One of the first things will be to increase the salaries of those who have devoted their ability to establishing and maintaining higher education in Wales. It cannot be expected that the services of the best men will be secured at the present inadequate salaries. The sacrifices made by those who have remained on in spite of better inducements elsewhere are appreciated, but the time has come to recognise the fact that if a first-rate staff is wanted it must be made worth while for the members of the staff to remain. At present the professors too often do work which ought to be relegated to tutors.

Turning to the question of research, Dr. Lloyd George pointed out that what is wanted is not only teachers, but also explorers. Science has its dark continents, unlimited continents—mapless, unlimited oceans—chartless. He would believe in the triumph of Welsh education when he could see sheets that are now mere outlines crowded with the discoveries of Welsh explorers. The greatest universities are, however, not the product of thirty years. There should be closer contact between the universities and the Welsh industries. Germany has said, "You must have a university to teach and to educate and to develop the German mind," and now the effect is seen in the German industries.

Dr. Lloyd George went into one of the largest workshops in Germany three months ago, and was taken round by a professor. He asked what a professor had to do with it, and was told "The professors are our experts." The Germans get their ideas from their professors. We in this country heave coal and blast rocks, but the great industries that finish these products are elsewhere. We must start as discoverers. All this is coming. Bangor has two factories, one in the lower town and one new factory the buildings of which are beginning to rise in Upper Bangor, while in Cardiff, also, new buildings have been erected for the University College, which, however, are not nearly so fine and imposing as the municipal buildings. These are the factories where the future of the country is being forged. There is no investment that will produce such a return, not to the investor, but to generations to come, as the endowment of higher education. The Chancellor of the Exchequer further referred to what has been done in the past by the people of Wales, the need of private as well as public support, and the future prospects of the University. G. H. B.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—Mr. J. M. Dobbs has been appointed chairman of the examiners for part i. of the mathematical tripos, 1909 (old regulations), and Mr. Fitzpatrick chairman of the examiners for the natural sciences tripos, 1909.

The general board of studies has approved for the degree of Doctor in Science Prof. W. W. Watts, F.R.S., and Prof. T. J. I'A. Bromwich, F.R.S.

The general board of studies will shortly proceed to the appointment of a university lecturer in zoology. Candidates are requested to send their applications, with testimonials if they think fit, to the Vice-Chancellor on or before December 2.

Mr. A. Wood has been appointed demonstrator of experimental physics.

London.—The Senate of the University has awarded the Rogers prize of 100*l.* for original research in medical science to be divided equally between Dr. David Forsyth, assistant physician to Charing Cross Hospital, and Mr. F. W. Twort, assistant bacteriologist to the London Hospital.

Manchester.—The completion of the new buildings of the Manchester Royal Infirmary, in close proximity to the University, has already led to a marked increase in the number of students entering for courses in the medical school. The new hospital, which is to be formally opened next year by His Majesty the King, is to be occupied by the end of the present month.

The new buildings of the engineering department are making rapid progress, and a portion is already in use. The extension of the chemical laboratories has also been commenced; the additional accommodation, which will cost from 15,000*l.* to 20,000*l.*, will be primarily devoted to the increasing requirements of research in organic chemistry.

The establishment of a new chair in botany, for which an endowment was received some months ago, is in contemplation.

The Court has resolved to recognise the Harris Institute, Preston, as a privileged institution, attendance at courses in mathematics, physics, and chemistry being accepted as satisfying the attendance requirements for the Inter. B.Sc. and Inter. B.Sc. Tech. courses.

Up to October 30 the number of students who have entered for courses of study in the University is 1320, against 1219 a year previously.

Dr. George Dean, chief bacteriologist at the Lister Institute of Preventive Medicine, has been appointed to succeed Prof. D. J. Hamilton in the chair of pathology in the University of Aberdeen.

Mr. G. H. Kenrick, Lord Mayor of Birmingham, has made a gift of 10,000*l.* towards the funds of Birmingham University. This is his third contribution toward the development of the University, his total gifts amounting to a sum of 25,000*l.*

Mr. H. G. Wells will preside at the first annual dinner of old students of the Royal College of Science, to be held at the Criterion Restaurant, Piccadilly Circus, on Wednesday, December 9. Dinner tickets, price 7*s.* 6*d.*, may be obtained from the honorary secretary of the dinner committee, Mr. T. L. Humberstone, 3 Selwood Place, Onslow Gardens, London, S.W. It is hoped that the dinner will lead to the formation of an association of old students of the college.

Prof. Perry has again sent us the balance-sheet referring to bursaries distributed by him to students at the Royal College of Science, South Kensington, during the two sessions 1906–7 and 1907–8. The fund for these bursaries represents a response to an appeal made by Prof. Perry for the means to assist deserving students at the college with secret gifts when necessary, it being understood that every student who receives such assistance shall repay the money to the fund when in a position to do so. Among the contributions to the fund are 100*l.* each from the Drapers', Goldsmiths' and Skinners' Companies, and 50*l.* from the Clothworkers' Company. As a number of students at the college have to maintain themselves and purchase their books and instruments out of scholarships having a value of about 17*s.* 9*d.* a week each, the institution by Prof. Perry of a system of small bursaries privately bestowed has provided a means of preventing unnecessary privation without injuring the self-respect of the recipients.

A common criticism of the methods of teaching science adopted in schools for girls is that they are too academic and have little or no bearing upon the duties the girls will be called upon to perform in after life. This weakness is, we are glad to know, becoming less common, and earnest efforts are being made in several centres to arrange courses of work in which elementary science and the home arts are taught together, the latter being treated largely as applications of the former. In a recent address to the Teachers' Guild, Mr. John Wilson, president of the Association of Technical Institutions, dealt exhaustively with the methods by which science can be connected with domestic training. His address is printed in *Education* for November 6 last. Mr. Wilson is of opinion that, ideally, the teacher should be a woman, thoroughly well skilled in chemistry and physics, &c., and a first-class diplomée in cookery, laundry work, and housewifery. At

present such women cannot be obtained. Referring to students undergoing training with the view of teaching home arts scientifically, he said the main difficulties the instructors of these students have to contend with are that, even at this late date, a number of the students have not had any previous scientific training at the secondary school. Many of the students *will* keep their minds in water-tight compartments. To them, the science work is one thing, the domestic subjects another, and between the two they draw no connections; and, greatest of all, to develop the subject logically we have to work in the laboratory from the simple to the complex.

LORD ROSEBERY, Chancellor of the University of London, in opening University College Hall, Ealing, on Tuesday, made some remarks upon the functions of a university. The hall provides a place of residence for students at the college. In declaring the building open, Lord Rosebery said it marked another milestone on that path of university development which seemed to open broader and with more promise at every step. First, the University of London was a purely examining university, then it developed into a teaching university, and now it is a university with some of the old collegiate aspects as well. The University is no longer, if it ever was, a purely London university; it is more and more developing into an imperial university. Each day sees it summoning from every part of Great Britain and of the British Empire students anxious to obtain the advantages of its constituent schools. A university should comprehend everything that is wholesome and valuable for the development of brain and of character. The hall now opened is one of the many symptoms of the growth of corporate life in the University. University associations of various kinds are growing up, and it is obviously a very thin-blooded, one-sided university that only provides for the intellect of its students. Human sympathy, human contact, all the valuable human elements that go to build up character are required, for a university which produces nothing but brain and neglects the formation of character is no university at all. The function of a university is not merely to pump knowledge into units by teaching and to extract it afterwards by examination, but to produce living men, who are going to take a part in the vast fabric of society within these islands.

THROUGH the generosity of Mr. Edric Bayley, who gave a sum of 5000*l.* to the building extensions, and by a large supplementary sum given by the County Council, a considerable extension has been made at the Borough Polytechnic Institute. It consists, in the first place, of a large examination hall, which can also be used for entertainments and public meetings, and below this hall new laboratories and class-rooms have been built. A very complete laboratory for oil and colour work is one of the most striking of the additions. This has accommodation for forty students, besides the lecture theatre, balance room, and laboratory; there is also a portion set apart for colour mixing and for grinding of colours, so that, besides working on the test-tube scale in the laboratory, the students can work on a semi-commercial scale. There is also an extension to the bakery department and a new book-binding workshop. The opening ceremony took place on Friday evening, November 13, when Lord Carrington, in a short speech, declared the buildings open. He referred to the fact that when he was at school, although the fees were high, they learnt very little except Latin and Greek. Science and laboratory equipment were absolutely unknown, and now in London, and also in the provinces, the highest scientific training can be obtained almost for the asking. He thought that the nation owed a very great debt of gratitude to public supporting men like Mr. Bayley, who made it possible for education to be placed within the reach of even the poorest. The chairman, Mr. Spicer, in his opening remarks said that the governing body will be well repaid for any trouble they have taken by the stimulus given to the work of the institute by the erection of these new buildings. Sir Philip Magnus, chairman of the education committee of the institute, said that the governors have always resisted the temptation to use the institute as a place for obtaining degrees, as it was founded to give education to the artisan classes, and they have always kept this object in view in any alterations or extensions. The trade classes are particularly fostered in the institute. Mr. Robinson, chairman of the London County Council, expressed his pleasure at being present, and said that the County Council, before it gives money, always wishes to know whether it gets value for money, and there is no doubt that in giving to an institute of this kind value is obtained.

THERE has been in recent years a serious decline in the number of pupils studying German in the secondary schools throughout the country. It is true that many subjects clamour for increased attention and others for recognition in the curriculum of these schools, while the number of hours available for instruction is limited. Headmasters find it difficult nicely to adjudicate between the conflicting claims; but from the point of view of the man of science and of the needs of great commercial houses the claims of German to generous recognition seem very strong. We are glad, therefore, to notice that a letter on the subject, signed by representatives of the Modern Language Association, the London Chamber of Commerce Education Committee, the Society of University Teachers of German, the Teachers' Guild, and the British Science Guild has been sent to the President of the Board of Education urging the paramount importance of encouraging the study of German in secondary schools. The letter points out that there is much to do if the unfortunate decay of German teaching is to be checked, and it proceeds:—"We therefore venture to suggest that your Board should consider the desirability of calling the attention of educational authorities, governing bodies, and the principals of secondary schools to the steady decline in the study of German, and should, by means of a circular, as in the case of Latin, or such other method as may be thought fit, submit to those authorities and to the public generally the many weighty and urgent reasons for regarding an acquaintance with German as being of the first importance to great numbers of young men and women, and a widespread knowledge of the language a national necessity. We would urge, moreover, that the Board should encourage and foster schools of the type of the German Realschule and Oberrealschule, in which two modern languages, but not Latin, are taught. The latter of these in Prussia ranks in standing with the Gymnasium, and its leaving certificate confers the same rights. Of schools devoting special attention to modern, as against classical, languages, there are at present in this country very few. Lastly, we would suggest that it should, as a general rule, be required that schools should make provision for the teaching of German to those pupils who wish to learn it, as it is now required that provision should be made for the teaching of Latin."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 28.—"Transparent Silver and Other Metallic Films." By Prof. Thomas **Turner.**

In a Bakerian lecture, delivered fifty-one years ago, Faraday showed that thin sheets of gold or silver, if mounted on glass and heated, became transparent. Beilby has also studied the annealing of gold-leaf and wire. The present research deals with a study of the conditions under which gold and silver become transparent, and extends the inquiry to copper and to certain other metals. It is shown that gold when about 1/300,000th of an inch in thickness becomes transparent if heated to 550° C. for a few moments. The effect is the same whether the atmosphere be oxidising or reducing, and if the supporting medium be changed. Transparency is due to the gold aggregating, and permitting white light to pass through the intermediate spaces.

In the case of silver the effect is quite different. No transparency is obtained with sheets about 1/120,000th of an inch in thickness so long as the atmosphere is a reducing one, such as hydrogen or coal gas. In air, however, transparency begins at about 240°, and is complete in a few moments at 390°. White light is now transmitted, and the transparency is remarkably complete. Transparent silver does not become opaque if heated in a reducing atmosphere, but it can be converted into the

opaque variety by burnishing, as in writing on the surface of the glass with an agate stylo. The change does not take place if silver-leaf be heated *in vacuo*, but it occurs readily with one-fiftieth of an atmosphere of oxygen. The silver does not increase in weight or the oxygen alter in volume, though oxygen appears to be necessary in order to produce the change. It is suggested that an oxide of silver may be momentarily formed and again decomposed by heat in the presence of more oxygen. The thinnest rolled metal obtainable, about 1/3000th of an inch thick, does not become transparent. Intermediate thicknesses have yet to be examined.

Thin sheet copper, about 1/75,000th of an inch in thickness, remains opaque when heated in a reducing atmosphere. In air or oxygen, however, it becomes transparent if heated for a suitable time at temperatures between about 200° and 400° C. At the lower temperatures the transparency is very marked, and the light transmitted is a brilliant emerald-green. As the temperature rises further oxidation takes place, and the colour gradually passes through olive and dark red to black. If the light-green transparent metal be treated with a diluted acid, metallic copper with a brilliant metallic lustre is obtained, while the green transparency disappears. The effect is due to oxidation, as the copper absorbs oxygen continuously during the heating.

Aluminium and Dutch metal do not appear to become transparent, nor have transparent films yet been obtained from sulphides. It is suggested that transparent films such as have now been obtained from copper are formed in all cases where a succession of spectrum colours are obtained on heating a metal in air.

Royal Microscopical Society, October 21.—Dr. J. W. H. Eyre, vice-president, in the chair.—The mouth-parts of the Nemocera, and their relation to the other families in Diptera—with corrections and additions to the paper published in 1904: W. **Wesché**.—(1) The resolution of periodic structures; (2) an auxiliary illuminating lens: E. M. **Nelson**.—*Micrococcus melitensis*: A. A. C. E. **Merlin** and E. M. **Nelson**.

Physical Society, October 23.—The meeting was held at the National Physical Laboratory, Bushy House, Teddington, by invitation of the director. All departments of the laboratory were thrown open for inspection, and, in addition, a number of special demonstrations were arranged.

Society of Chemical Industry, November 2.—Dr. Lewkowitsch in the chair.—Chemical industry in relation to agriculture: Prof. A. **Frank**. After referring to the great services of Liebig to agriculture, the author gave an historical survey of the manufacture and agricultural uses of, phosphates, and the production of potash. Ammonium sulphate, Chile saltpetre, and the utilisation of atmospheric nitrogen were also discussed, and an account was given of the author's own work in effecting the combination of atmospheric nitrogen with carbides of the alkalis and the alkaline earths. By decomposing the calcium cyanamide with water under high pressure ammonium salts are formed. Possibilities of calcium cyanamide as a fertiliser are dealt with, and some statistics relating to the output of calcium carbide are included. The work of Mond on the simultaneous production of power gas has made it possible to utilise the large stores of energy accumulated in bog areas in the form of peat. The author and Caro, with the assistance of Mond, have been able to gasify peat containing 50 per cent. to 55 per cent. of water without difficulty.

Zoological Society, November 3.—Mr. Frederick Gillett, vice-president, in the chair.—Mammals from Inkerman, near Townsville, North Queensland, collected by Mr. W. Stalker and presented to the National Museum by Sir William Ingram, Bart., and the Hon. John Forrest: Oldfield **Thomas** and Guy **Dollman**. The collection showed clearly that the Townsville region belonged faunistically to North Australia, the species being nearly identical with those of New South Wales and Victoria. Several species and subspecies were described as new.—(1) Takins from Sze-chuen and Bhutan; (2) An Indian dolphin and porpoise: R. **Lydekker**.

Paris.

Academy of Sciences, November 9.—M. Bouchard in the chair.—The president announced to the academy the death of M. A. Ditte.—The products of the reaction of sodium amide on ketones: A. **Haller** and Ed. **Bauer**. Benzophenone, treated in benzene or toluene solution with sodium amide, if the materials are perfectly free from moisture, gives the compound $C_6H_5C(ONa)(C_6H_5)(NH_2)$, and this on treatment with water regenerates the benzophenone, together with ammonia and caustic soda. In presence of a trace of water a different reaction takes place, and the addition of water to the reaction product gives benzene, benzamide, and caustic soda. This reaction appears to be general with the aromatic ketones, anthraquinone being an exception.—The mode of formation of the Puy de Dôme and the rocks which constitute it: A. **Lacroix**. A detailed examination of the structure of the Puy de Dôme shows that it is comparable, not with Mt. Pelée, but with Guadeloupe. Each of the domes, forming the chain of the Puys, has a distinct history requiring separate examination.—M. Henneguy was elected a member of the section of anatomy and zoology in the place of the late M. A. Giard.—Physical observations of the comet 1908*c*, made at the Observatory of Lyons: J. **Guillaume**. A detailed account of the numerous changes in the appearance of the nucleus and tail of this comet observed between September 5 and October 20.—The use of compasses of great magnetic moment: Louis **Dunoyer**. A discussion of the theory of the correction of compasses of great magnetic moment (2000 to 5000 C.G.S. units). The formulæ developed have been submitted to an experimental control.—The geometrical applications of certain remarkable movements: J. **Haag**.—The formation of centres of gyration behind an obstacle in motion: Henri **Bénard**. The vortices produced behind a cylinder moving in a liquid with a uniform velocity were studied by means of kinematographic methods. The vortices were spaced at equal distances behind the moving body, this equidistance being found to be independent of the velocity, but increasing in the same direction as the viscosity of the liquid.—The ionisation of phosphorus and phosphorescence: Léon and Eugène **Bloch**. Experiments are described proving that phosphorescence, ionisation, and ozone are all produced in the same region. This region can be completely separated from the phosphorus if the velocity of the air current is increased above a certain limit, and it is possible to separate this region several metres from the phosphorus. These facts indicate that the phosphorescence, ionisation, and the ozone are not produced by the direct oxidation of the solid phosphorus, but by the oxidation of a substance emanating from the phosphorus and carried off by the gaseous current. This substance is most probably phosphorus anhydride.—The radio-activity of the gases from the thermal water of Uriage (Isère): G. **Massol**. The gases escaping from the water have a radio-activity only one-fourth of that of the gases remaining dissolved in the water. This emanation evaporates at the same time as the water; the saline residue from a half-litre of the water evaporated on the water bath was completely inactive.—The polarisation of the living man submitted to the action of the continuous current: M. **Chanoz**.—The radio-activity of the waters of Uriage-les-Bains (Isère): Paul **Besson**.—Contribution to the study of lenses: C. **Maltézos**.—A monotelephone with a note capable of regulation: A. **Blondel**. The apparatus is less sensitive than that recently described by M. Abraham, but possesses the advantage of being less easily broken.—The reaction of the ether on matter as the cause of universal attraction: O. **Keller**.—The true atomic weight of silver according to the experiments of Stas: Louis **Dubreuil**. The author has applied the method developed by him in a previous paper to the experiments of Stas on the atomic weight of silver. The general mean arrived at is 107·9021, or practically 108.—The alloys of silicon and silver: G. **Arrivaut**. The current views regarding the existence of a silicide of silver are divergent, Wöhler, Warren, and Chalmot regarding the existence as proved, Percy, Moissan, and Vigouroux holding the opposite opinion. The author has determined the melting points both of the first crystallisation and the eutectic of a series of mixtures of silver and silicon. The results do not sup-

port the view of the formation of a definite compound of the two elements.—The identity of ilicic alcohol with α-amyrine: E. **Jungfleisch** and H. **Leroux.** Ilicic alcohol was isolated by J. Personne from birdlime, and was regarded by him as an alcohol of the formula $C_{25}H_{44}O$. This alcohol is completely identified by the authors as identical with α-amyrine, an alcohol met with in various resins, but the composition $C_{30}H_{50}O$ is shown to accord best with its analysis and that of its derivatives.—Sparteine. A new method of cyclisation of α-methylsparteine by the action of iodine: Amand **Valeur.**—The eruptive rocks of Gebel Doukhan (Red Sea): M. **Couyat.**—The discovery of a Quaternary human skeleton: Émile **Rivière.** The discovery of this skeleton was announced in 1905. The present note is chiefly occupied with the proof that the skeleton is really of the same age as the deposits in which it was found.—Certain cutaneous spots resisting the action of radium and disappearing under the influence of the high-frequency spark: Foveau **de Courmelles.**—Concerning the anatomical characters of *Bradypus torquatus*: M. **Anthony.**—The presence of limestones containing *Productus giganteus* in Nova Zembla: G. W. **Lee.**—A new type of petiole of the fossil fern: Fernand **Pelourde.**—Contribution to the study of the transformation of sedimentary deposits into sedimentary rocks: J. **Thoulet.**—The seismic movements of November 6, 1908: Alfred **Angot.**—The subterranean river of La Grange, Ariège: E. A. **Martel.**

CAPE TOWN.

Royal Society of South Africa, September 16.—Mr. S. Hough, F.R.S., president, in the chair.—The pollination of *Belmontia cordata*: Dr. **Marloth.** The flowers are scented, and possess small appendages at their anthers, called Brown's bodies. They contain a sugary fluid, and this, it has been ascertained now, attracts a tiny, small insect, hardly a fifteenth of an inch long, belonging to the thrips family. The flowers possess two kinds of stigmas for the reception of the pollen, a structure which is not known from any other plant. This secondary stigma secures pollination in case the terminal stigma should not have received some pollen in time.—Embryo-sac of the Penæaceæ: Miss E. L. **Stevens.** The embryo-sac of this order differs from that of the typical angiosperm in containing sixteen nuclei instead of eight (these sixteen nuclei being organised into four egg-apparatus) and a definitive nucleus formed by the fusion of four of the nuclei. The early stages in the development of the sac show none of the polarity considered to be so characteristic of the angiosperm sac, and the whole structure of the sac is confirmatory of Dr. Pearson's hypothesis regarding the origin of the endosperm of angiosperms.—Endosperm: Prof. H. H. W. **Pearson.** It is suggested that the endosperm of the angiosperm is derived by a series of reductions and degrees of specialisation from a primitive type, essentially similar to that now found in Welwitschia. This hypothesis is strengthened by the fact that stages in this process can be identified in living angiosperms.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 19.

ROYAL SOCIETY, at 4.30.—Memoir on the Theory of the Partitions of Numbers. Part IV.: On the Probability that the Successful Candidate at an Election by Ballot may Never at any Time have Fewer Votes than the One who is Unsuccessful; on a Generalisation of this Question; and on its Connection with other Questions of Partition, Permutation, and Combination: Major P. A. MacMahon, F.R.S.—The Propagation of Groups of Waves in Dispersive Media, with Application to Waves on Water produced by a Travelling Disturbance: Dr. T. H. Havelock.—On the Refraction and Dispersion of Krypton and Xenon and their Relation to those of Helium and Argon: C. Cuthbertson and M. Cuthbertson.—Note on Horizontal Receivers and Transmitters in Wireless Telegraphy: Prof. H. M. Macdonald, F.R.S.—On Optical Dispersion Formulæ: Prof. R. C. Maclaurin.—(1) On the Accumulation of Helium in Geological Time; (2) On Helium in Saline Minerals and its Probable Connection with Potassium: Hon. R. J. Strutt, F.R.S.—Note on the Effect of Hydrogen on the Discharge of Negative Electricity from Hot Platinum: Prof. H. A. Wilson, F.R.S.—On Measurement of Rotatory Dispersive Power in the Visible and Ultra-violet Regions of the Spectrum: Dr. T. Martin Lowry.

CHEMICAL SOCIETY, at 8.30.

LINNEAN SOCIETY, at 8.—On a New Species, Symphyla, from the Himalayas: Prof. A. D. Imms.—The Freshwater Crustacea of Tasmania, with Remarks on their Geographical Distribution: Geoffrey Smith.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Inaugural Address by the President: Mr. W. M. Mordey.

FRIDAY, NOVEMBER 20.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Resistance of Materials to Impact: Dr. T. E. Stanton and L. Bairstow.—Different Methods of Impact Testing on Notched Bars: F. W. Harbord.

MONDAY, NOVEMBER 23.

ROYAL SOCIETY OF ARTS, at 8.—Twenty Years' Progress in Explosives: Oscar Guttmann.

TUESDAY, NOVEMBER 24.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Primitive Pottery and Iron Making in British East Africa: W. Scoresby Routledge.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion:* Glasgow Central Station Extension: D. A. Matheson.

WEDNESDAY, NOVEMBER 25.

ROYAL SOCIETY OF ARTS, at 8.—The Goldfields of Eastern Peru and Bolivia: Sir Martin Conway.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, NOVEMBER 26.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Some Experiments made to test the Action of Extract of Adrenal Cortex: S. G. Shattock and C. G. Seligmann.—Further Results of the Experimental Treatment of Trypanosomiasis; being a Progress Report to a Committee of the Royal Society: H. G. Plimmer and Captain H. R. Bateman, R.A.M.C.—A Trypanosome from Zanzibar: Colonel Sir David Bruce, C.B., F.R.S., and Captains A. E. Hamerton, D.S.O., and H. R. Bateman.—The Proportion of the Sexes produced by Whites and Coloured Peoples in Cuba: W. Heape, F.R.S.—Further Researches on the Etiology of Endemic Goitre: Captain R. McCarrison, I.M.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Domestic Electricity Supply (including Heating and Cooking) as affected by Tariffs: W. R. Cooper.

FRIDAY, NOVEMBER 27.

PHYSICAL SOCIETY, at 5.

CONTENTS.

THURSDAY, NOVEMBER 26, 1908.

EXTINCT FRENCH BIRDS AND AMERICAN TORTOISES.

Les Oiseaux des Phosphorites du Quercy. By C. Gaillard. Annales de l'Université de Lyon, nouv. série: I., Sciences, Medicine, Fascicule xxiii. Pp. 1–178; plates i–viii. (Lyon: A. Rey et Cie.; Paris: J. B. Baillière et Fils, 1908.)

The Fossil Turtles of North America. By O. Perry Hay. Pp. iv+568; plates i–cxiii. (Washington: Carnegie Institute, 1908.)

WHEN working at the vertebrate remains from the phosphorite beds of Central France, the late Dr. Filhol made over the whole collection of bird-bones from these deposits in his possession to his colleague Prof. Milne-Edwards, by whom they were described and named in a memoir communicated to the second Ornithological Congress held at Budapest in 1891. Almost at the same time the present writer was engaged on a catalogue of the fossil birds in the British Museum, and as this was published a few months earlier than the report of the congress, his names antedate those of his French colleague. With these works as a starting-point, Dr. Gaillard has for several years past been endeavouring to amplify and consolidate our knowledge of the bird fauna of the phosphorites, and the memoir now before us is the result of his labours. Not only has a very large number of actual specimens passed through his hands, but he has obtained plaster-casts of the phosphorite bird-bones from almost all the museums in Europe, thus enabling him to carry out his task in a manner which would otherwise have been impossible.

Unfortunately, all the bird-remains from the French phosphorites occur in the form of isolated and frequently imperfect bones, so that it is in many cases a matter of extreme difficulty to associate bones of one part of the skeleton with species or genera passed on those from another portion. In this matter the author appears, however, to have been wonderfully successful.

As the result of his labours, Dr. Gaillard is enabled to identify more than forty species of birds from the phosphorites, which are referable to five-and-twenty genera. Although these represent only a small percentage of the bird-fauna of that epoch, they are sufficient to indicate its extremely interesting character. The main interest is concentrated on two points:—first, the indications of affinity between groups now more or less widely sundered; and, secondly, the remarkable evidence of the mingling of what are at present exclusively African with exclusively South American types. It should be added that, with very few exceptions, the genera are extinct.

As regards the first point, it must suffice to mention that the genus described as Strigogyps appears to present structural resemblance to the owls, on the one hand, and to the vultures (and the diurnal birds-of-prey generally) on the other.

In connection with the second point, it is most noteworthy that while secretary-birds, sandgrouse, the game-birds of the genus Palæocryptonyx, and rollers and turacos (Geranopterus and Dynamopterus) give to the fauna a notably African and Indo-Malay facies, on the other hand, a number of types, such as Plesiocathartes (a relative of the condors), Orthocnemus, Elaphrocnemus, Filholornis, and Archætrogon (which respectively resemble the chajas, the hoatzin, the guans, and the trogons) present an equally marked approximation to the modern avifauna of South America. Such resemblances form one more link in the chain connecting the Tertiary fauna of Africa with that of South America, and the varied materials of which the links in that chain are respectively constructed render it difficult (despite the persistent efforts that have been made to explain away the force of the evidence) to give any satisfactory explanation of the resemblance other than a former land-connection between the two continents across the Atlantic. For his labours Dr. Gaillard merits the thanks of all naturalists.

To an English ear the title of the second of the two memoirs quoted at the head of this review scarcely gives an adequate idea of its contents, as in this country we are accustomed to restrict the term turtle to the reptile so well known at City feasts and its immediate relatives, whereas on the other side of the Atlantic it seems to be taken to include tortoises and terrapins. In yet another respect this bulky quarto volume is more than it seems, since it contains, in addition to its proper subject, an excellent dissertation on the structure, taxonomy, and distribution of the Chelonia. In this respect it may be noticed that the author adopts the suggestion made several years ago by the present writer as to Chelyidæ (instead of Chelydidæ) being the proper form of the family name derived from Chelys.

The study of American fossil chelonians commenced with Leidy in 1851, since which date an almost continuous advance has been made, with a specially large output of work during the last few years. In the present volume no fewer than 266 species are recognised, of which 76 are described for the first time. The author has made a special point of endeavouring to examine, whenever possible, the type-specimens of each species; in some cases these have, however, been irretrievably lost, and in others mislaid.

A special feature of American fossil Chelonia is the number of species belonging to the group termed by the present writer Amphichelydia, of which the typical representative is the British Jurassic genus Pleurosternum. In North America the group is very largely represented by the allied family Bænidæ, which shows greater specialisation in the structure of the vertebræ of the neck and of the bony buttresses connecting the lower with the upper shell. Another very characteristic family of American chelonians is the Cretaceous Toxochelyidæ. The author furnishes some interesting suggestions with regard to the phylogeny of the Chelonia, and likewise discusses their supposed relationship to the Sauropterygia.

Almost the only fault we have to find with the volume is the absence of a good table of contents, or

of a classified synopsis, whereby the serial positions of all the genera and species might be seen at a glance. In all other respects we heartily congratulate Mr. Hay on the completion of such a valuable and heavy piece of palæontological work. R. L.

APPLIED GEOGRAPHY.

Applied Geography. By Dr. J. Scott Keltie. Pp. viii+199. Second edition. (London: G. Philip and Son, Ltd., 1908.) Price 2*s*. 6*d*.

SINCE the appearance of the first edition in 1890, this work has been recognised as an authoritative and coherent statement of human industry and progress from the point of view of geography. The demand for a new edition has provided the opportunity for a thorough revision of the work, involving the addition and consideration of new material now available; and the result is a volume in which the dry bones of what is known as commercial geography are articulated so that their relationship to each other, and to the life of man, can be clearly distinguished.

It is sometimes said that geography is not a science; and in so far as it deals only with the collection of facts there is justification in the remark. No branch of natural knowledge can claim a place in the hierarchy of the sciences until the facts with which it is concerned have been classified, generalised, and shown to lead to productive principles. In the past, geographers themselves have not realised that this is the ultimate aim and intention of scientific investigation, and have mostly been content with the accumulation of facts without attempting to construct an organic system from the material. Few have worked on Baconian principles with the object of discovering by systematic inquiry the true significance of the facts.

That definite principles can be deduced from geographical material is illustrated by many statements in Dr. Keltie's book. Consider, for instance, the relation of rainfall to population and to animal and vegetable commodities. Neglecting the local influence of minerals, manufactures, and transport, it may be said that population is relatively low where the rainfall is deficient or excessive, and high where rainfall favours the growth of grass, grain, and other food products. The density of population in many parts of India is in exact proportion to the rainfall, and the number of sheep that can be grazed per square mile in Australia also varies with the rainfall, being at the rate of twenty-two sheep per square mile for every inch of rain above nine inches. Wheat also shows a similar relationship, the harvest in South Australia being on the average 12·5 bushels per acre for a rainfall of 18·5 in., 10 bushels for 15 in., and 6·5 bushels for 13·5 in. An extra inch of rain in the season would thus represent in South Australia a gain of about 10,000,000*l*. These are examples of geographical principles derived from the coordination of meteorological and economic data by scientific inquiry.

Though Dr. Keltie gives many similar instances of the relation of various factors of climate to the products and commercial value of a country, he omits to mention that the distribution of rainfall through the year is more important than the actual amount. Grass lands require not only an annual rainfall of about thirty inches, but also a distribution of this quantity throughout the year at intervals not exceeding a month. Wheat-growing also depends upon the distribution; and with some varieties can only be successfully carried on where the percentage of winter rains is largely in excess of that for the summer months. Given the meteorological conditions and the character of the soil in any part of the world, it is possible to state what variety of wheat will come to maturity there, or whether the region is unsuited to wheat culture. Here then we have the facts of meteorology, agriculture, botany, and economics, leading to a conclusion of high significance to the human race; and it is only one of many examples of applied geography.

"From neglect or ignorance of known geographical conditions," says Dr. Keltie, "or from taking no steps to counteract them, the most serious disasters to crops and flocks were of constant occurrence in Australia, though, recently, improvements have been introduced. It is, therefore, the most short-sighted policy imaginable in a young colony to neglect the survey of its territories; public money cannot be better spent than in the maintenance of an efficient survey service, and a carefully selected network of meteorological stations."

Man is, of course, able to modify natural conditions or adapt his demands to them. Irrigation has converted barren land into fertile fields; insanitary and malarious regions have been rendered habitable as the result of biological observation and experiment; and hindrances to commerce have been overcome by engineering enterprise. In this connection, the author says, "By deafforesting here and planting there, we have been able appreciably to modify rainfall, and therefore climate." There is, however, little evidence for this belief. No amount of afforestation or deafforestation will modify the direction or frequency of rain-bearing winds; forests do not, in fact, affect greatly the rainfall of a region, but they assist in conserving the moisture actually received, and when they are destroyed the soil may be washed away or the loss by evaporation and percolation increased.

When referring to the relation of man himself to the resources around him, Dr. Keltie remarks, "Had a different type of man from the Chinese, men like ourselves, possessed that vast territory, how different the results would have been." The explanation of undevelopment is not, to our mind, due so much to the type of man as to the beliefs and traditions accepted by the people. The Chinese are as industrious and ingenious as any Western race, and when they awake to the knowledge that the wisdom of the past is insufficient for the needs of to-day and the future they will make even more substantial advances than Japan has done. Until the study of science had been transferred from books and authority to nature by observers like Paracelsus, Leonardo da Vinci, Galileo, Gilbert, and Gesner, Europe was in the dark ages, and the conclusions of Aristotle, Ptolemy, and other sophists were regarded as the final standard of judgment by which the validity of natural fact or theory

should be tested. Only when independence of observation and thought had been secured by the pioneers of modern science was progress possible. Any race which places the wisdom of its early fathers above the work of its sons, which regards past knowledge as sufficient for future salvation, must remain stagnant. Mr. G. G. Chisholm accurately expresses the application of this fact to China in the "International Geography" in the following words:—

"All Chinese institutions concur in impressing on the people respect for authority and the established order. None is more influential in this respect than the system of examination, for all the examinations test merely the knowledge of the ancient Chinese classics first systematised by Confucius, and give no encouragement to the spirit of independent inquiry."

It would be easy to select numerous other points from Dr. Keltie's book for description or comment. The six chapters in the volume deal respectively with general considerations, geography applied to commerce, the geography of Africa in its bearings on the development of the continent, the British Empire, some common commodities, and the unstaked or unexplored parts of the earth. Each chapter is rich in information, and the style of the whole work is far removed from that of books in general on commercial geography. Our only regret is that a book which embodies so many facts of importance should be published without an index.

QUAIN'S ANATOMY.

Quain's Elements of Anatomy. Edited by Prof. E. A. Schäfer, F.R.S., Prof. J. Symington, F.R.S., and Dr. T. H. Bryce. In four vols. Vol. i., Embryology. Eleventh edition, by T. H. Bryce. Pp. viii+275. Price 10*s.* 6*d.* net. Vol. iii., Neurology. By Prof. E. A. Schäfer, F.R.S., and Prof. J. Symington, F.R.S. Part i., containing the General Structure of the Nervous System and the Structure of the Brain and Spinal Cord. Price 15*s.* (London: Longmans, Green and Co., 1908.)

WHEN in 1828 Jones Quain, "Lecturer in the Medical School, Aldersgate Street," published, as a modest volume, the first edition of his "Elements of Anatomy," he could scarcely have hoped that eighty years later it would still remain the standard work of its kind in the English language, and that it would take and keep a place as a cosmopolitan textbook; and yet if the truth must be told, very little of Quain remains in the work which now passes under his name. In the original edition a chapter of some 4000 words told the story of the development of the human body; now, in the eleventh edition, embryology requires a special editor and a special volume containing more than 100,000 words and considerably more than 300 illustrations.

The new edition is marked by a number of changes, some of them of considerable magnitude. Chief amongst these is the change in the editorial staff, and it will be with very sincere regret that anatomists, not only in England, but in every country, will see that Prof. George Dancer Thane's name no longer appears on the title-page. In width and accuracy of anatomical knowledge, in clearness of statement and draughtsmanship, he has no compeer amongst present-day anatomists. Dr. T. H. Bryce, lecturer in anatomy in Queen Margaret College, Glasgow, has joined the editorial staff, replacing Prof. Schäfer as editor of the volume dealing with embryology. The present edition is to appear in four volumes, of which the volume by Dr. Bryce, containing the embryology, is the first; general and visceral anatomy will constitute a second, the nervous system and sense organs a third, the remaining subjects being grouped together in a fourth volume. It is to be hoped that, as in the last edition, each of these remaining volumes will be issued in separate parts, for big volumes are very inconvenient for reference and use. In the present edition the "general introduction" has been wisely omitted, for it shared the character of nearly all introductory chapters in being unintelligible until the whole contents of the work had been mastered and appreciated by the student. It is also to be hoped that the precedent set by the present volume of referring readers to foreign text-books for the literature of the subjects dealt with is not to be followed in the other volumes, although it must be admitted that Dr. Bryce does supply references to important papers of more recent date.

In preparing a new edition of "Embryology," Dr. Bryce's task was not an easy one, and he has done it well. In the eighteen years which have elapsed since the last edition was published there has been a remarkable extension in every phase of our knowledge of the development of the human body. Especially is this true of the early stages in the development of the human embryo and of its attachment to the uterus. The ova described by Leopold, Peters, Beneke, and Graf v. Spee, represent earlier stages than were known when the last edition was published, and it is not improbable that the specimen described by Drs. Bryce and Teacher since the present edition was ready for publication represents a younger stage of the human embryo than has been hitherto seen. Our conception of the manner in which the ovum becomes embedded in, and attached to, the uterus has undergone a complete revolution. The elaborate changes undergone by the nucleus of the cell, especially those nuclear changes which preceed the formation of genital cells, have been recently investigated by a large army of workers, a line of research, if one may judge from the space here devoted to it, with which Dr. Bryce has a particular sympathy. On the other hand, later stages of development are dealt with very meagrely, and the descriptions of the origin of such organs as the lungs and prostate are far too slight to be of real use. It is strange, too, that a book which is primarily intended for medical men should provide so imperfect an explanation of the many malformations to which the various parts of the human body are liable.

A study of the text makes it very evident that Dr. Bryce has regarded a full and accurate description

of observed and verified fact as the chief duty of the editor of a work such as Quain, but however much one may applaud his aim it cannot be said that his style is a happy one for descriptive purposes. The following instance may be selected from p. 251, and it is by no means an isolated example :—

"The formation of the vertebral body is brought about as follows: the notochordal sheath becomes prolonged dorso-ventrally into a kind of septum, which extends between the primitive plates and separates the loose mesenchyme, alluded to above, into a right and left moiety; at the same time the superficial layers of the intervening tissue become condensed into a continuous lamella uniting the plates and enclosing the looser tissue on each side of the septum. This enclosed tissue now becomes converted into cartilage. There are necessarily at first two chondrogenetic centres, but soon the septum becomes implicated, and the notochord is enclosed in a continuous cartilaginous ring."

Now the body of a vertebra is a very simple thing, but the reviewer, after reading and re-reading Dr. Bryce's description, has been unable to obtain a mental picture of how it is formed, and most students will find the same difficulty. The first essential of a descriptive text is that it must be clear and simple, and very frequently Dr. Bryce's text has neither of these merits. As regards the interpretation of fact and statement of theory, the editor has rightly assumed an impersonal and non-committal attitude; he leaves the reader free to make his own choice. He has given an impartial representation of the work and theories of most embryologists, with one exception; in describing the origin of primitive sex cells, not a word is mentioned of the arduous and pioneer work of Dr. Beard, of Edinburgh.

A large number of new illustrations have been added, many of those by Dr. Bryce, such as Fig. 136, showing a stage in the development of the nerve roots, being of real merit, but on the other hand it must be admitted that the illustrations prepared from photographs of sections of the embryo and fœtus are almost of no value whatsoever, for it is only the expert who can make any use of such sections, and these they have already by the score in their store cupboards. In exercising the rights of a reviewer, perhaps the many merits of this new edition have been sacrificed to an enumeration of what the reviewer regards as demerits, and it is only just to Dr. Bryce to mention in conclusion that the former far outweigh the latter.

In part i. of vol. iii. Profs. Schäfer and Symington have produced a standard work on the structure of the central nervous system. The combination of physiologist and anatomist has had the happiest result, securing at once an authoritative representation of what is known of the finer structure as well as the gross anatomy of the brain and spinal cord. The volume is richly and wisely illustrated, many of the new figures by Prof. Symington being of great merit. One has only to compare it with the corresponding volume of the last edition to realise the extraordinary progress that has been made during the last fifteen years in every part of our knowledge of the brain.

A. K.

NATURAL AND SYNTHETIC CAMPHOR.

La Canfora Italiana. By Prof. Italo Giglioli. Pp. 292. (Rome: Tipografia Nazionale di Giovanni Bertero e. C., 1908.)

THE commercial production of camphor is, at the present time, in a very interesting phase. The true camphor tree, *Cinnamomum camphora*, one of the Lauraceæ, occurs wild in eastern Asia, Formosa and Japan yielding the greater portion of the world's supply. After the Chino-Japanese War, the Japanese, by the acquisition of Formosa, gained the practical control of the total output, and camphor production was made a Government monopoly, first in Formosa, but afterwards in Japan as well. Within a short space of time camphor rose enormously in price, causing serious concern in the industries employing camphor, particularly the manufacture of celluloid, which uses up the greater portion of the world's supply.

This condition of affairs, and the possibility, as a further development, that celluloid manufacture might also become a Japanese monopoly, gave a great impetus to research with the object of preparing camphor artificially or of finding some efficient substitute. The chemists proved equal to the occasion, and camphor was prepared synthetically by using turpentine oil as a raw material, the successive products in one of the processes being the terpene pinene, pinene-hydrochloride, camphene, bornyl acetate, borneol, and finally crude camphor, which, when refined, yields camphor identical in all its properties with the natural product except that it is optically inactive, a difference, however, of no economic importance.

Not only has the synthesis of camphor been successfully accomplished, but the synthetic camphor can be prepared at a sufficiently low price to enable it to be a formidable competitor to the natural product, and it is at present a moot point as to whether the natural or artificial camphor can be produced the more cheaply. Natural camphor in the past was obtained by the destructive method of felling mature trees, cutting up the wood into chips, and subjecting these to distillation. The experiments carried out during recent years at the Royal Botanic Gardens, Ceylon, and elsewhere have shown that this is not essential, and that camphor can be obtained from the young twigs and shoots, and it is possible that by coppicing the plant instead of allowing it to assume its normal tree habit much greater yields can be obtained per acre, and the cost of production considerably reduced. Synthetic camphor, on the other hand, unless other large supplies of suitable hydrocarbons become available, will remain dependent on turpentine oil, which during recent years has shown a tendency to increase in price.

The Japanese monopoly not only encouraged researches aiming at the artificial production of camphor, but also gave a stimulus to the cultivation of the tree in other countries, the work in Ceylon already referred to being a case in point. Prof. Giglioli, in the volume under review, deals with this aspect of the question as regards Italy. Many people, asso-

ciating the camphor tree with its close ally, the cinnamon (*Cinnamomum zeylanicum*), are inclined to regard camphor as a product of tropical, or at any rate distinctly hot, countries. As a matter of fact, it is rather a plant for subtropical and warm temperate regions, and it is noteworthy that Mr. H. N. Ridley, F.R.S., in a recent number of the Agricultural *Bulletin of the Straits Settlements and Federated Malay States*, records that the finest camphor tree he has ever seen outside Japan was one growing near Fowey, in Cornwall. The tree thrives in many parts of Italy, where the average yield of camphor from green leaves is given by Prof. Giglioli as 1·20 per cent., which is very similar to that obtained in Ceylon, and considered sufficient for commercial purposes.

Prof. Giglioli enters fully into the history of camphor, its cultivation in various parts of the world, describes the mode of extraction and preparation of the product, shows by chemical and industrial tests that camphor of good quality can be produced in Italy, and is of opinion that a successful industry there is quite feasible. Finally, it is worth noting that the book has as footnotes and in a special appendix very full bibliographic references to all aspects of the subject.

W. G. FREEMAN.

POPULAR GARDENING.

Garden Rockery: How to Make, Plant, and Manage it. By F. G. Heath. Pp. vi+173. (London: George Routledge and Sons, Ltd., 1908.) Price 1*s*.

THE object of this popularly-written book is frankly stated by the author in the preface as "to show the worn and worried man, or woman, of business how to obtain a maximum of enjoyment with a minimum of preliminary attention and consideration." It appears to be an attempt to induce those who have but little time, or inclination, for gardening, to take up a branch of that art which in our opinion demands sympathetic treatment and constant ungrudging attention to small details of cultivation.

We sympathise with any efforts that are made to popularise gardening, but it is to be feared that the contempt for high cultivation expressed in many of the author's remarks is scarcely likely to be helpful to those who may be desirous of maintaining their rockeries in a condition that will afford most pleasure to their owners. Eden may, or may not, have "yielded food and fruit not, at any rate, inferior in quality to that of our own times," but whatever may be the truth in regard to such a statement, we feel sure that, with very few exceptions, the fruits of the earth, as we know them, are much improved by cultivation, including in this term the processes of cross-breeding and selection of varieties. But the author declaims against the "vicious practice" of developing single into double flowers, or of making the naturally white flower blue, red or yellow.

"Nature's variations in form and colour," he says, "are endless, and should suffice for the most exacting horticultural taste, without the display of cunning efforts to alter her wise disposition of form and colour."

All this, it would appear, has little to do with the making or planting of rockeries, but this book discusses such questions before asking in the third chapter "What is Rockery?" Subsequent chapters give directions as to what materials to use in the formation of a rockery, and describe how rocks are generally seen in a state of nature, whether of volcanic origin or the result of the "weathering" of exposed rocks.

A list of British ferns is given, and some of the commoner flowering plants that may be cultivated on rockeries, and the text is relieved with forty-five illustrations which have been reproduced from photographs. There are several mis-spellings in the lists, and whilst many of the terminations of the specific names appear to have been purposely brought into conformity with the recommendations of the Vienna Conference, there is no consistency in this matter.

In one of these lists *Linaria cymbalaria* is described as growing 3 inches high, but upon a rockery it is surely more useful for this species to *trail* 24 inches. The author speaks of *Primula vulgaris* as the *wild* plant, and suggests that it is the progenitor of such species as *P. farinosa, P. scotica, P. floribunda, P. auricula*, and others, but these plants are just as *wild* as *P. vulgaris*, and we are unable to discover the evidence upon which the author bases his deduction. Of *Linnaea borealis* (mis-spelt *Linnea*) the author timidly states that it is believed this plant was named after Linnæus, because it was understood to be a favourite plant of his! The plant was undoubtedly named by Gronovius, not only after the great botanist, but at his request.

FLOREAT CANADA!

Canada's Fertile Northland. Evidence heard before a Select Committee of the Senate of Canada, 1906–7. Edited by Captain E. J. Chambers. Pp. 140; with illustrations and a volume of maps. (Ottawa: Government Printing Bureau, 1908.)

WITH characteristic foresight, the Government of Canada has collected such information as is available regarding the possibilities of the northern regions of the dominion as a field for immigration. The title of these cloth-bound volumes is attractive, and certainly optimistic. The evidence of those who know the country, given with simple directness, does not emphasise its fertility, and it soon becomes obvious that a large part of the 1,637,559 square miles discussed has emerged so recently from the Glacial epoch that soils have only just begun to form. It is fair to add that a very large part remains unsurveyed and unprospected.

The handsome maps provided record geographical advances made in quite recent times, and there are still some inviting areas worthy of a Sven Hedin or a Nansen, skilled in the lore of stream and forest. For the agriculturist there are many assurances that potatoes are not cut off by frosts in summer; but the raising of wheat is naturally more precarious. Mr. Tyrrell (pp. 89–93) describes a forest-belt south-west of Hudson's Bay as suitable for agriculture, owing to the warm bright summers. "The snow

leaves the ground in May, . . . and the frost does not appear in the fall until about September 20." Mr. F. S. Lawrence's experiences with wheat in the Peace River country (latitude $58\frac{1}{2}°$ N.) provide valuable information (pp. 101–105). Spring wheat has fully matured here in eighty-six days. The word "muskeg" is used freely by witnesses, and is not very lucidly explained on p. 123; it appears to be a poor wet kind of soil, which may be as much as 6 feet in depth, and is generally to be avoided.

The simple and unvarnished statements of the various witnesses furnish a manly contrast with the prospectuses of company-promoters, and from them we gather that timber and minerals will probably form the main attraction for new settlers. The evidence of Mr. A. von Hamerstein (pp. 36–43) is full of delightful touches. Like Mr. Lawrence, he speaks highly of the Peace River valley, but remarks sadly of the climate of the Athabaska district:—"They say it may change, but up to this time it has not changed." He mentions places where small areas of good soil occur, but says that at Fort Chipewyan "a little garden stuff is raised, on soil brought there by the Sisters in pails." His account of the moral defects of the wolverine, among which is an objection to taking poison, should delight the naturalist. This animal has hung behind in the march of evolution, for "the horse and other animals have developed, but the wolverine has kept his original shape."

We close the book with renewed admiration for those who are engaged in making Canada. There is to be no "boom"; no hardships are to be concealed; the settler is invited to follow the trapper and the Indian, and to see if he can make more out of this enormous tract than they have done. In latitudes below those of Stockholm and the Orkneys, or even as far south as Belfast or Newcastle-upon-Tyne, he is called on to meet the rigours of a continental winter. But he is encouraged by diagrams showing the length of summer days and the shortness of summer nights, themselves as starless as the days; and the cover that encloses so much plain speaking is labelled "Canada's Fertile Northland." Success should surely come to those who have this high faith, and tell no untruths while spreading it.

G. A. J. COLE.

OUR BOOK SHELF.

The Functional Inertia of Living Matter. A Contribution to the Physiological Theory of Life. By Dr. D. F. Harris. Pp. xi+136. (London: J. and A. Churchill, 1908.) Price 5s. net.

THE book before us deals, mainly from the physiologico-philosophical standpoint, with a property of living matter which has excited the interest of biologists, and which, indeed, has been the field, not only of much speculation, but also of much experiment. The fact that certain forms of living matter, whether they are integral parts of a highly-developed and differentiated organism, or whether they consist of more or less apparently undifferentiated protoplasm, either do not respond at all or respond only after varying intervals of time to certain stimuli has long been known, and the condition of the protoplasm in question during this time has long been investigated by biologists. We use the term *apparently* undifferentiated advisedly, since, as has been often pointed out, it is sometimes a matter of extreme difficulty to know whether, when dealing with the infinitely simple, we are not really dealing with the infinitely complex.

Dr. Harris's brochure is an elaborate, for the most part literary, examination of this subject, and quite apart from the conclusions he draws from his investigations is of considerable interest, and will well repay the reading. In a short review of this nature it would be quite impossible to consider in even approximate detail the facts related in the book, the observations upon which they rest, or the interpretations to which they are open. The property of living matter upon which the non-response to stimuli or the so-called latent period preceding response depends is termed by the author functional inertia. He at first introduces this term, so well known and accurately applied by physicists, somewhat apologetically, as perhaps complicating physiological nomenclature; in reviewing the literature of the subject, however, he finds many precedents for the use of the term inertia as describing the resistance offered by living matter to any change in its condition. Perhaps to others, as was actually the case to the reviewer, the first cause to occur to one's mind, of failure on the part of living matter to react to stimuli, is fatigue. Dr. Harris discusses fatigue and its bearing upon functional inertia.

In a short summary the author postulates that functional inertia is as fundamental, primary, and primitive a property of protoplasm as its opposite, irritability, and that the phenomena of vitality cannot be adequately conceived in one of these properties exclusively.

We would conclude our remarks upon Dr. Harris's work by simply saying that it is interesting and suggestive, and well worthy of careful perusal, not only by those interested in the many observations relating to the phenomena of the latent period accompanying the stimulation of living matter, but also by those interested in the larger if less accurately conditioned field of biophysical philosophy.

F. W. T.

The Elementary Theory of the Symmetrical Optical Instrument. By J. G. Leathem. Cambridge Tracts in Mathematics and Mathematical Physics, No. 8. Pp. vi+74. (Cambridge: University Press, 1908.) Price 2s. 6d. net.

MAKING a Cambridge tract is a feat, performed in this instance with a finish of which the writer may well be immensely proud. The Gauss theory of refraction through a series of media bounded by spherical surfaces having the same optic axis admits of being handled with that deftness which is the most marked characteristic of the Cambridge mathematician, and which is here admirably exemplified. All the essentials of the Gauss theory are condensed into some fifty octavo pages, and so clearly set out that the average mathematical student should have no difficulty in absorbing the whole in a few hours, to forget it, not impossibly, with equal readiness.

For, in spite of some reference to concrete instruments and some remarks on certain facts of observation not generally recognised, the book remains—unavoidably, perhaps, in view of its aim and its limited space—essentially academic. It will be grateful to the student, and appreciated by the mathematician already familiar with the matter it presents, but we fear there are few designers of symmetrical optical instruments, in this country at least, to whom it will appear attractive—in spite of the avoidance of the now familiar continued fraction. In its very

conciseness it assumes a mathematical training which many of them have never had, and which is much more difficult to acquire even than a knowledge of continued fractions. In some measure, no doubt, it is they who are at fault, and certainly they are the losers.

Such criticism is, obviously, to some extent beside the mark. But it recurs inevitably with the appearance of each fresh Cambridge text-book on geometrical optics. An excellent book; but if only the author had written something which would more obviously advance the practice of optics and the manufacture of optical instruments!

To our mind, the most interesting part of this admirable little tract is contained in sections ix. and x. Section ix. gives a simple and concise explanation of the occurrence and physical importance of von Seidel's five third-order aberrations, very palatable and nutritious for the mathematician! And in section x. is to be found an up-to-date abstract of the elementary theory of the characteristic function, which will be helpful to many. The contents of the tract will have been sufficiently indicated if we add that the titles of sections vii. and viii. are respectively "Entrance and Exit Pupils" and "Chromatic Defects of the Image."

In conclusion, we venture to assert that Mr. Leathem's exposition of the Gauss theory will be adopted as the most serviceable by every optician who takes the trouble to become familiar with this book, and we would add that he will find his trouble well repaid.

Hints for Crystal Drawing. By Margaret Reeks. With a preface by Dr. John W. Evans. Pp. xx+148; with 5 figures and 44 plates. (London: Longmans, Green and Co., 1908.) Price 3s. 6d. net.

THE importance of accurate drawings of crystals in any crystallographical discussion was recognised by Haüy, the father of crystallography, but the principles upon which such drawings should be made were not clearly explained until the publication by Haidinger of his well-known paper among the memoirs of the Wernerian Society many years later. It is essential that edges which are parallel on the crystal should be represented by parallel lines on the drawing, a condition which entails the supposition that the eye views the crystal from an infinite distance. Consequently, in such a special case as a skeletal cube in which the edges are drawn of equal thickness, the eye would be puzzled as to which is the front, and the cube would appear constantly to be turning inside out; but, as a rule, no such ambiguity would arise. It is also important that the directions of the edges in the drawing should be determined with mathematical precision, even when the crystal is shown in perspective.

In this book Miss Reeks presents Naumann's modification of Haidinger's method. She explains how the projection of the fundamental axial system may be found graphically in the six different systems, and discusses many examples, all of which are illustrated by full working details. It might have been made clearer on p. 7 that the particular rotations employed to give the customary perspective were adopted, not haphazardly, but because the tangents of the angles have the simple ratios given. The student who carefully reads this book cannot fail to master the principles of the method with which it deals; the author's exposition is lucid, and the illustrations, which have been reproduced from her own drawings, are admirable. It may, however, be questioned whether in most cases it be not quicker and easier to draw a crystal from a stereographic or a gnomonic projection by the method devised by Goldschmidt, which was fully explained to English readers by Penfield in one of his illuminating papers.

House-painting, Glazing, Paper-hanging, and Whitewashing. A Book for the Householder. By A. H. Sabin. Pp. v+121. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 4s. 6d. net.

MR. SABIN may be known to some readers of NATURE as the author of a pleasantly discursive volume on the technology of paint and varnish. In the present little work he expounds one branch of that technology for the benefit of householders. He describes simply and plainly how to use various preservative coatings in the protection and embellishment of ordinary dwelling-houses.

There is no chemistry in the book, but a chemist tells of the materials to use—of the white lead, turpentine, oil, driers, putty, varnish, and whitewash—as also of the points to note and the pitfalls to avoid in applying the preparations. Whether many householders will benefit is perhaps doubtful. Possibly, in America, where isolated homesteads are more frequent, the householder may be more often than in this country tempted to do his own painting and papering. Here it would rarely seem worth while. There is a proverb about spoiling a horn and not making a spoon, and probably the unskilled user of paint, paper, and varnish would generally do well to get his work done better by a trained craftsman. Even so, however, there is no harm in knowing what are the best materials, how to get the most durable results, and the general why and wherefore of the matter. For anyone who contemplates either trying his own skill or overlooking the proceedings of a workman, Mr. Sabin's book appears, as he claims in the preface, to "set forth fairly safe and sound practice."

C. S.

Mountain Panoramas from the Pamirs and Kuen Lun. Photographed and annotated by Dr. M. Aurel Stein. Pp. 36. (London: Royal Geographical Society, 1908.)

WHEN Dr. Stein visited Central Asia in 1900–1, to explore the ruined cities of Chinese Turkestan, he included in his equipment a phototheodolite, with which a number of panoramas were taken. These not only served as a basis for the production of a map, but gave an excellent idea of the character of the country passed through. The Royal Geographical Society has now published a selection from them which will prove of interest to both geographers and geologists. A feature common to a large number of the photographs is the manner in which they illustrate the progressive desiccation of the region lying north of the Himalayas; the sharp crested ridges, separating deeply-cut valleys, produced by the action of rain and rivers, are seen to be gradually merging into rounded contours under a growing mantle of wind-borne loess. We may also direct attention to the remarkably perfect specimens of embankment moraines in the Ab-i-Panja valley, where glaciers, now vanished, have advanced into the main valley over embankments of the *débris* which they have carried along with them.

Thomas Linacre. By Dr. William Osler, F.R.S. Pp. vi+64. (Cambridge: The University Press, 1908.) Price 2s. 6d. net.

THIS little volume is the text of the Linacre lecture for 1908, the first under the new regulations. Prof. Osler begins by recapitulating the few facts

known of Linacre's career, and then sets out the subject of his remarks as medical humanist and grammarian, and closes with the Linacre foundations themselves. On a theme so well worn no very striking facts can be expected, but we have a very readable presentation of the man himself, as shown in his works and benefactions to his own university and to Cambridge. The plates in half-tone are of the Holbein-like portrait attributed to Quentin Matsys, a copy of a drawing in the British Museum, and facsimiles of title-pages of nine of his printed works.

B. D. J.

Lands Beyond the Channel. An Elementary Study in Geography. By H. J. Mackinder. Pp. xii+276. (London: George Philip and Son, Ltd., 1908.) Price 1s. 9d.

If geography could be learnt satisfactorily by reading alone it would be difficult to find a more suitable and attractive reading book than this. The Mediterranean Sea and Europe are described by the aid of interesting text and numerous maps and pictures. Historical paragraphs emphasising the interrelation of history and geography are frequent, and the pupil who reads the volume intelligently will have accumulated a great deal of curious and useful information. But for the right understanding of geography as a science this descriptive matter must be supplemented by carefully graduated practical exercises, judiciously designed to lead the learner to a knowledge of the foundations upon which geographical science rests.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Earthquakes and John Wesley.

The year 1755, the year of the great Lisbon earthquake, is so remarkable for its seismic activity that any facts relative to earthquakes in that year have their value, and I have recently stumbled on some information from a rather improbable source, viz. the journal of John Wesley.

On Monday, June 8, 1755, he was at Osmotherley, in Yorkshire, and made inquiries of eye- and ear-witnesses of the occurrences of March 25 preceding, and he describes what he heard of noises, motions of the earth, falling and splitting of rocks, and other seismic phenomena which occurred in that neighbourhood, and especially at Whiston Cliffs, about five miles from Thirsk. These phenomena, which commenced on March 25, seem to have gone on, if I read Wesley's statement aright, with intervals to the end of May. Wesley was so much interested in what he heard that on June 1 he made a personal visit to the chief scene of the desolation, and he gives a long and interesting account of what he saw in the vicinity of the Whiston Cliffs. He then proceeds to discuss the cause of what he had seen; if the cause were natural, it must, he says, have been fire, water, or air. He discusses and dismisses each of these as the possible cause, and concludes that it was the direct intervention of God at a spot near where the Hamilton races were held, "wrought in such a manner that many might see it and fear." In Mallet's catalogue of earthquakes (British Association reports for 1852) disturbances are mentioned at York on March 25 and 27 on the authority of *Kant. Géol. Phys.*, t. iv., p. 314, but no further mention is made of the facts stated by Wesley.

I may further add that Wesley also mentions and describes earthquakes in London on February 8, 1750, and March 8, 1750, neither of which is mentioned in Mallet's catalogue.

The passages in which Wesley describes these several seismic facts are too long for citation in your columns, but appear to me well worth reading alike by the seismologist and by the student of Wesley's character. They show an inquisitive mind interested in natural facts, but with a strong tendency to find immediate and direct moral teaching as their final cause.

EDWARD FRY.

Failand House, Failand, near Bristol, November 17.

Large Blue Whales.

I have just acquired for the Canterbury Museum the skeleton of a huge blue whale (*Balaenoptera sibbaldii*).

Tail of a Blue Whale stranded at Okarito.

The whale was cast on to the beach at Okarito, on the west coast of the South Island of New Zealand, early this year, and measured 87 feet in length.

My statement that the Okarito whale is among the largest known has been freely challenged in the local Press. The "Ostend whale," the length of which is rendered as 102 feet, has been instanced, but Beddard ("A Book of Whales," p. 155) evidently discredits the record as to size.

A Danish correspondent refers to the skeleton of a whale 150 feet in length, killed off the Orkneys and preserved in the Museum of Northern Antiquities, Copenhagen. Others state that specimens larger than ours may be seen in the British, Paris, and American museums.

I have naturally sought information as to the length of skeletons of great whales preserved in museums, but have been unable to obtain satisfactory data.

I shall be pleased, therefore, if directors of museums possessing the skeletons of large whales will kindly communicate with me direct, or, as the matter is one of general interest, through the medium of NATURE.

EDGAR R. WAITE.

Christchurch, New Zealand, October 8.

Potato Black Scab.

Referring to Prof. Johnson's letter in NATURE of November 19 (p. 67) on the black scab or wart disease of the potato, I should like to emphasise the importance of investigating in the open as well as in the laboratory the conditions determining the germination of the resting spores.

Like Prof. Johnson, I have found no difficulty in germinating them in potato-juice at the ordinary laboratory temperature. At the commencement of August they had liberated their contents within four days in a hanging-drop culture. I was not so fortunate as to observe the actual escape of the zoospores, but this stage seems to be followed very rapidly by the amœboid stage, in which condition the organism moves about very actively for some days. In the hanging drop it then becomes passive, withdrawing its pseudopodia and assuming a spherical shape.

In both the ciliate and the amœboid condition it must be very sensitive to fungicides, and it is therefore important to ascertain at what period this susceptible stage is reached in nature, as this will determine the best time for the application of gas lime or other dressing to the soil. Now that so many observers are directing their attention to this fungus, it is to be hoped that we shall soon discover a method of checking the further advance of this destructive parasite. F. E. WEISS.

The University, Manchester, November 21.

Mercury Bubbles.

I HAVE on several occasions noticed the beautiful bubbles described by Mr. Wright and Sir William Crookes (pp. 8 and 37). On each occasion I was purifying mercury in the following way. I half filled a rather large Woulffe's bottle with mercury and poured on to it weak nitric acid. Then, in order to keep the whole in a state of agitation, I carried a tube through one neck to the bottom of the bottle and attached a short tube to the other neck connected with a filter pump, so that air was continuously drawn through the two liquids. I have never noticed bubbles for the first hour or two, but afterwards they are formed continuously, and float for a second or so on the top of the acid before bursting. Some were certainly quite 22 mm. in diameter. From their delay in appearing I gather either that they are only formed in mercury which is fairly pure, or that the nitric acid has to be fairly well saturated with metal. A. T. HARE.

November 23.

WITH reference to Mr. J. G. Ernest Wright's letter in NATURE of November 5, I may be permitted to mention that under the above heading I published a few observations in NATURE of July 2, 1903. Like Mr. Wright, I made an approximate estimate of the thickness of the mercurial pellicle, but the bubbles which were produced in Mr. Wright's experiment seem to have had a slightly greater diameter than any of those which I observed.

HENRY H. DIXON.

School of Botany, Trinity College, Dublin.

An Alga growing on Fish.

IN NATURE of April 18, 1907, vol. lxxv., p. 599, it is noticed that Mr. A. D. Hardy found a cholorophyte, *Myxonema tenue*, ordinarily an inhabitant of rapid streams, also growing luxuriantly on some goldfish in a small pond, thus obtaining water friction necessary to its own well-being.

To some of your readers it might prove of interest to record a similar occurrence in Japan. On October 11, 1902, while I was rambling about the Asso marsh, not far from this town, my eye was accidentally caught by a small fry of *medaka* (lit., eyes-jutting, *Haplochilus latipes*, Schleg.), a fish proverbial for its diminutiveness. In a shallow bog-pool, only some 2–4 feet across, they looked very unhealthy, and were swimming in an unsteady, fidgety manner, infested with what appeared to be Saprolegnia, but greenish in hue. On a closer examination, every one of them turned out to have under or beside its abdomen a horny protuberance giving rise to delicate tufts of an alga up to 1 cm. long. This discovery I made mention of in a letter sent some time after to Prof. G. S. West then at Cirencester. This plantlet, I have no doubt, belongs to the genus Myxonema, but the imperfection of my microscope, as well as the want of reference books, prevents me from ascertaining what species it really is.

By the accompanying parcel post I am sending you five *medaka*-fish with the algal growth *in situ*, and two slides with the latter; also one slide with a large, broadly shuttle-shaped and much constricted desmid found singly suspended among the Myxonema, in the hope that some phycologist will kindly identify them for me.

KUMAGUSU MINAKATA.

Tanabe, Kii, Japan, September 20.

THE alga attached to the *medaka* fish is *Myxonema tenue*, Rabenh. The desmid is a species of Euastrum, too imperfect to determine specifically. A few fragments of a diatom belonging to the genus Gomphonema are also present. GEO. MASSEE.

A Disclaimer.

I WISH to make a disclaimer of responsibility with reference to the journal *Ion*, on the cover of the first number of which my name figures in the capacity of an editor. It is true that at one time, acting on certain representations, I accepted an invitation to superintend the department of the journal dealing with radio-activity, as referred to in the concluding paragraph of the editorial on p. 1 of the first number. Neither the journal itself, nor its cover, however, were submitted to me for my sanction and approval before publication. The appearance of my name on the cover in the capacity of an editor has not been authorised by me, and I accept no responsibility with regard either to the editing or publishing of the journal.

With reference to the department of the journal dealing with radio-activity, I would point out that the first number of the journal contains several articles and reports dealing with the subject of radio-activity, but with the exception of two articles contributed by myself and one report, proofs of which passed through my hands, these articles and reports were not seen by me before publication. The first intimation I had that they were to appear was derived from the advertisement of the journal and its contents in NATURE of November 12, p. xxi. I therefore do not accept any responsibility for that section of the journal I am stated to have the care of. Finally, I wish to say I have now withdrawn from all connection with the journal.

FREDERICK SODDY.

Leonid Meteors.

THE nights of November 13–15 appear to have been generally overcast, and to have furnished no opportunities for watching the display of meteors. But November 16 was clear at some places, and Mr. Ellison Hawks, of Leeds, counted eighty-seven meteors between 10h. and 14h., of which twenty-six appeared to be certainly Leonids, while many others pursued nearly same paths, and probably belonged to same stream. Large meteors were recorded at 12h. 26m. and 13h. 12m. shooting from Taurus and Aries towards the planet Saturn.

At Whitby an observer noticed several conspicuous meteors in the morning hours of November 17. At 6.32 a.m. there was a splendid one descending almost vertically through Orion from the direction of Leo, and there was no doubt that the great November stream returned, though perhaps not richly as in some years nearer the perihelion returns of the parent comet. It is to be hoped that other observers will send their reports of the shower.

The night following Monday, November 16, when the Leonid meteors were seen at Leeds and Whitby as described, was decidedly late for the display. The present year being leap year, it is probable that the shower was at its best on the mornings of November 15 and 16, but no accounts of its appearance at those times have reached me owing to the overcast and starless condition of the visible firmament reported by various observers.

W. F. DENNING.

THE ETHNOGRAPHY OF ASSAM.

THE new volumes of the ethnographical series issued by the Government of Eastern Bengal and Assam, in continuation of Major Gurdon's excellent monograph on the Khasis, are devoted to an account of the Mikirs and the Meitheis. These manuals are in pleasing contrast in appearance to ordinary Anglo-Indian ethnological publications. Printed in England, the format is all that could be desired, and they are fully equipped with excellent half-colour illustrations, photographs, and maps. It is to be hoped that the success of this series will encourage the Central Provinces authorities to issue similar accounts of the Gonds and their kinsfolk, and the Madras Government to arrange for the issue of Mr. Thurston's Bulletins in less inartistic form.

The volumes now before us illustrate the varying condition of the savage or semi-savage tribes on the eastern frontier. The account of the Mikirs, based on materials collected by the late Mr. E. Stack, and largely supplemented by the editor, Sir C. Lyall, describes a race which has been little affected by civilisation. The monograph on the Meitheis of Manipur, prepared by Mr. T. C. Hodson, late superintendent of the State, describes an interesting tribe which has been deeply influenced by the culture and religion of the Hindus. The plan of these monographs is uniform, separate chapters dealing with the geographical distribution, physical characteristics, culture and social life, laws, customs, and religion, to which are added a grammar of the tribal dialect and a chrestomathy which contains a number of folk-tales in the local language, accompanied by an English translation. The reader is thus provided with abundant materials for the study of some of the most interesting tribes within the Indian Empire.

FIG. 1.—Mikir Man. Reproduced by permission from a coloured plate in "The Mikirs."

The Mikir tribe, numbering 87,000 souls, inhabits a hill tract lying south of the Brahmaputra river, abutting on the east on the Naga country, and on the south on that of the Khasis. Their ethnical affinities are still somewhat uncertain. Dr. Grierson, on linguistic grounds, classes them as intermediate between the Boro and Western Nagas, while Sir C. Lyall, mainly on ethnographical evidence, connects them with the tribes forming a link between the Nagas and the Kuki-Chins, especially those dwelling south of the Arakan Roma range, where the Chin tends to merge into the Burman of the Irawadi valley. They are a peaceful agricultural people, accustomed to depend for protection upon the more warlike neighbouring tribes, like the Khasis, from whom they have assimilated much—dress, ornaments, personal names, methods of divination, funeral rites, and the habit of erecting memorial stones, besides many additions to the tribal vocabulary. From the Assamese Hindus they have borrowed certain elements in their language, folk-tales, and religion. At the same time, they have enough which is original about them to make them interesting. Thus the absence of matriarchal institutions clearly distinguishes them from the Khasis; in physique they differ both from Assamese and Khasis; they build their houses on posts, while their neighbours, except the Kukis, build on the ground. In their animistic reverence for Nats they resemble the Burmese. But to this primitive animism they have added from Hindu sources the conception of a hell and a paradise, with a vague belief in metempsychosis. These views, however, do not influence their ideas about a life to come.

The Meitheis of Manipur, though possessing a long and eventful history, were little known in Europe until the tragedy of 1891, when Mr. Quinton, Chief Commissioner of Assam, and other British officers were treacherously murdered. As is the case with the Mikirs, their ethnical affinities are uncertain, but, in spite of their desire since their conversion to Hinduism to affiliate themselves to the Aryan race, they are probably an offshoot of one of the hill tribes like the Nagas. When the Raja and Rani perform the rite of ascending the throne, they wear Naga dress, and the architecture of the coronation hall, with its front beams crossed and carved, suggests the decoration of the Khullukpa houses in Naga villages.

FIG. 2.—Rās Costume. Reproduced by permission from a coloured plate in "The Meitheis."

Though the Brahmans of Manipur date their settlement from the fifteenth century, Hinduism did not become the State religion until the middle of the seventeenth. It is still only a veneer on the primitive animism, its chief social result being the abolition of hunting, except in the case of tigers, for the destruction of which village clubs, with a due provision of nets and spears, are established. Hinduism has brought with it new restrictions in regard to food and drink, but it has removed the curious taboo on the use of milk characteristic of the Indo-Chinese races.

Considerations of space prevent us from directing the attention of anthropologists to all the points of interest in these monographs. Specially noticeable among the Mikirs are the annual compulsory village festival, when sacrifice is made to Arman-paro, the

"hundred god," and to the local deities of hill and river, the flesh being consumed only by the men, who must live apart from their wives during the rites; the cremation of the dead with subsequent interment of the bones, the ceremonies including an elaborate animal sacrifice and a tribal dance; the bachelors' club of youths associated for agricultural work, which is now passing into decay. Among the Meitheis may be noted the selection of a man who gives his name to the year, bears all the sins of the people during that period, and whose luck, for good or ill, influences the luck of the whole country. Sportsmen will be interested in the account of polo, with its primitive regulations. Introduced into Manipur from the Indo-Tibetan region about 1600 A.D., the possibilities of the game were suggested to British officers by Manipur teams which played at Cachar and Calcutta.

SOME SCIENTIFIC CENTRES.

No. XIV.—The Hortus Botanicus at Amsterdam.

THE name of one of the most famous centres in the domain of biology conveys little idea of what goes on there to the average English-speaking man, unless he knows already. The Experimental Garden—as this centre is called—in the Hortus Botanicus at Amsterdam is a laboratory in which the results for which it is famous have been obtained, not by experiment, but by observation, as we usually understand these terms.

This is not the place to discuss the question whether a line can be drawn between experiment and observation; nor, supposing that one can, to attempt to arrive at some conclusion as to where observation ends and experiment begins. But it seems to us that the whole essence and significance of de Vries's work lies in the fact that it has been a work of observation. De Vries's name will be remembered as that of the man who saw what Darwin foresaw; who spent his life in carefully observing and accurately recording the process of the origin of species.

To appreciate the nature of the work which has been done in the Experimental Garden, it is necessary to take a brief glance at the main features of the previous attempts to deal with a problem which, until de Vries attacked it, resisted all attempts to solve it satisfactorily. This survey will also serve to explain more fully what is meant by the statement that de Vries's work was, in the main, one of observation.

The history of the efforts of biologists to deal with the problem of evolution, as told by de Vries in his "Mutationstheorie," is a history of the gradual improvement of the power of observation, which first saw in the genera the units of the natural system; then the Linnean species; and, finally, the elementary species of which the Linnean species are composed. At each stage in this history, the observer very naturally regarded as the ultimate unit of the natural system that unit which he saw by focussing his faculty of observation on it as finely as he could. In pre-Linnean days, the genera were regarded as the units; from then until now, the Linnean species have been so regarded, and the modern view, put forward by de Vries, is that the Linnean species are compound things, being, in fact, composed of the elementary species, which are the real units of the natural system.

In pre-Lamarckian days, the chief attribute of the real unit of the natural system was that it had been created, and had not arisen by natural means. So that when Linnæus elevated the species to the rank of the unit of the natural system they acquired this attribute automatically. *Species tot numeramus quod diversae formae in principio sunt creatae* are Linnæus's words. It is a very interesting fact that Linnæus knew that his species were capable of further subdivision into what he called *varietates minores*; but these had arisen by natural means, and so were not worthy of the attention of the serious student. *Varietates levissimas non curet botanicus* were the words in which he forbade his students to pay any attention to them. The fads of genius are not buried with their authors. Prof. de Vries himself can remember pointing out on one or two occasions, when a student, curious abnormalities and instances of apparent subspecific characters to his professor, and being told by him not to pay any attention to them. He has occupied the rest of his life in doing so.

The nucleus of the Experimental Garden at Amsterdam was a certain potato-field near Hilversum, not far from Amsterdam. It had been bounded on its southern side by a canal from time immemorial. In 1870 the owner of the field, Mr. Six, had an extension of the canal dug along its western and part of its northern side; the result of which was that the original access to the field on its northern border was blocked, and that it could only be reached by its eastern side, where, however, there was, unfortunately, no road. Mr. Six found himself unable to let the field, and decided to plant it with trees. Rough paths were accordingly cut, and small trees planted.

Here was a wonderful opportunity for the wild plants, which had been kept in check with the hoe year after year, to establish themselves and multiply —an opportunity for the supercession of the horticultural by the cosmic process, to borrow Huxley's famous illustration. Yet, curiously enough, the fullest advantage of this opportunity was taken, not by an indigenous species, but by an introduced one which had spread over into the field from a small bed in a park close by, where a few annuals were grown every year. It was the beautiful evening primrose, *Œnothera Lamarckiana.*

De Vries first saw the field in 1886. The Œnotheras spread over a wide zone, the centre of radiation of which was the point at which the species had invaded the field. The centre of this zone was covered by a dense jungle of Œnotheras as tall as a man; outside this zone the adult plants gradually gave way to younger ones, whilst outside of all was an advanced guard of rosettes which did not lift their heads above the level of the ground.

All this seemed to offer to de Vries an opportunity which might never occur again of studying the phenomena of variation as exhibited by a plant multiplying, practically without restriction, in a state of nature. Moreover, he had been trying for some years past to find plants in a state of mutation (that is, of giving off new elementary species) but in vain. Œnothera broke the spell of failure. It was in a mutable period; new elementary species were arising; two had already arisen in the potato-field, *Œnothera brevistylis* and *Œ. laevifolia.* It very soon became evident that, to observe the process of the origin of mutations properly, it was necessary to grow the plants under direct personal observation in one's own garden. In the first place, only a very small proportion of the seeds that are shed in nature can germinate, and, of those that do, a very small proportion can attain maturity; so that if a mutation does arise the chance that the seed which contains it will survive to maturity is small. In the second place it is impossible to know the parentage of any of the plants in the field, partly because it is not possible to know from which plants the seeds which gave rise to

them have come, and partly because, even if this were known, it would still not be known whether they were the result of a self- or cross-fertilisation.

Œnotheras were therefore transported from the field at Hilversum to the garden at Amsterdam. This was done in one of two ways. Either the young first year's rosettes were transplanted (*Œ. Lamarckiana* generally behaves as a biennial, flowering in the year after that in which it was sown), or seed was collected from the mature plants in the field at Hilversum and sown in the garden at Amsterdam.

The expectation, based on the appearance of two new species in the field, that more would arise in the garden was fulfilled. There arose altogether about a dozen new elementary species in the garden. The work of investigating the mode of origin of these new species consisted partly in finding out if the relative numbers of these species appearing every year were at all constant, and, if so, what the "mutation coefficient" (as this number was called) was; it consisted also in testing the constancy of each new species through several generations. Besides this, de Vries was continually on the look out for new species, and for this purpose large sowings of Œnothera seed were made every year. Moreover, crossings between the various elementary species were continually being carried out. The number of plants which had to be examined in the course of this work was enormous; and the number could not have been so great, nor the work so thorough, if de Vries had not paid special attention to the distinguishing characters of the seedlings of the various species.

His plan at first, *i.e.* shortly after the transportation of Œnotheras from Hilversum to Amsterdam, was to sow the seed directly in the bed in which the plants were to flower. The disadvantage of this plan was that all the seed did not come up in the first year; so that, in the first place, all the crop arising from a single sowing could not be recorded at one time, and, in the second, the bed could not be used for another sowing until it was certain that all the seed from the last had come up. Moreover, weeding and the minute examination of the seedlings was not by any means convenient in these circumstances. This plan was therefore soon forsaken, and that of sowing the seed in pans adopted in its stead. The pans were filled with soil which had been baked, a process which killed any seeds which might be in the soil, so that there was no possibility that any of the Œnotheras which came up could have arisen from any other source but the seeds deliberately sown in the soil, and the tiresome and difficult process of weeding was rendered unnecessary. The seedlings could be examined much more minutely and thoroughly in the pans than in the beds.

Prof. de Vries in his greenhouse.

The result of this innovation was that de Vries acquired a most intimate familiarity with the seedling characters of the various new elementary species; this is to a certain extent putting the cart before the horse. It is perhaps truer to say that the majority of the new species which were discovered after the introduction of this innovation owed their discovery to the fact that they differed from the parent form in the seedling stage.

Perhaps the most valuable improvement in the equipment of the Experimental Garden was one which was made possible by the practical way in

which his former students and friends expressed their admiration for de Vries and his work, on the occasion of the twenty-fifth anniversary of his professorship at the University of Amsterdam. On this occasion de Vries was presented with a considerable sum of money, which was expended in the erection of a vast greenhouse, which enabled him to defy the climate of Holland, against which he had been contending for many years with anything but complete success.

The Experimental Garden at Amsterdam, as it now stands, is the result of an attempt to perfect a method of observing the origin of species. The success of this attempt will rank as one of the greatest achievements in biology.

THE SURVEY OF AFRICA.[1]

THE fifth volume of the account of the geodetic survey of South Africa, executed under the supervision of Sir David Gill, has now been issued. With the four volumes previously published the description of the whole work, from the southernmost point of the continent up to the Zambezi River, is thus completed. A sixth and final volume is promised, which will comprise that portion of the thirtieth meridian arc done by Dr. Rubin, carrying the survey northward from the Zambezi to a point 70 miles south of Lake Tanganyika. This will therefore round off the South African part of this great undertaking, the first idea of which was originally conceived by Sir D. Gill in 1879. To him, together with his able lieutenant, Colonel Sir W. G. Morris, the credit of thus carrying through this immense task, in face of many political and financial difficulties, must be ascribed.

The present volume is replete with interest both to the scientific surveyor and to the student of public policy on the questions of survey and map-making. The main interest naturally centres about the introduction by Sir D. Gill, and the introductory report on the trigonometrical survey of the Transvaal by Sir W. G. Morris. The former gives a succinct history of the triangulation of South Africa, recapitulates the now well-known proposal to extend the thirtieth meridian arc through the continent, and concludes with a detailed *résumé* of the negotiations between the Imperial Government and the colonial authorities for the formation of a federal survey department. These extended, with intermissions, from 1901 to 1904, and finally ended abortively, one colony after another deciding that they could not afford the expenditure necessary for the construction of an accurate map of their territory. The expenditure ultimately and implicitly involved by the existence of inaccurate maps or by the complete non-existence of any maps at all, being an item which does not come on the estimates for the year, is, we must perforce conclude, a subject of little concern to the politician. Otherwise, unless we are to assume that public memory is so short that a period of three or four years is sufficient to drive the most striking events out of mind, it is difficult to see how one of the main object-lessons of the South African war, *the extreme costliness of bad maps*, should have been so soon and so completely set aside. Sir D. Gill's account not unnaturally gives special prominence to those parts of these proceedings which took place in Africa, with which he was directly concerned. The result is that he does less than justice to the part played by the War Office, and is apparently unaware that the proposal to carry out a complete survey of South Africa, by cooperation between the Imperial and the colonial authorities, was put forward by that office long before the date of the similar suggestion by Colonel Morris, referred to on p. 16.

The whole history of this geodetic work is a curious inversion of the general order. Usually it is the complaint of the map-maker that, whereas it is not difficult to get money from a Government department for the immediate, practical work of mapping, it is a more laborious task to persuade them of the necessity for a liberal expenditure upon the fundamental geodetic triangulation. In South Africa the exact reverse of this has been the case, and we have the anomalous position of a complete triangulation system without the resulting maps; even as yet it is only in the case of the Orange River Colony and partially in Cape Colony that any of the maps of the country are based upon the positions of the geodetic points.

Of the technical part of the report the most interesting is undoubtedly the account of the base measurements carried out with invar wires hanging freely, at a constant tension, between low tripod supports. Five bases in all, totalling a length of 70 miles, were measured. Each was gone over with the wire three times, and the apparent probable error varied from 1 part in 1,000,000 at the Belfast base, where the staff was inexperienced, down to nearly 1 part in 7,000,000 in the most favourable case. Sir D. Gill maintains that, with a trained staff, a base can be measured in this way with an actual final uncertainty of less than 1 part in 1,000,000 say, 1 inch in 15 miles—a contention apparently justified by the figures. The rate of progress, including the time spent on the wire comparison with the standard bars, averaged 475 yards per day, and the cost was high—153*l*. per mile of base. In view of this, and in view of the fact that a limiting error of 1 part in 1,000,000 implies a much higher degree of precision than that attained by the angular observations, it would seem more practical, for similar work in the future, to make the bases both shorter and less accurate, and, therefore, cheaper and more rapidly executed. This would have the effect of preserving that balance between the degrees of precision of the different parts of the work so essential to the economical conduct of a cycle of physical operations.

The horizontal angles were observed with the 10-inch Repsold theodolite, the probable error of a single angle being found to be $0''.30$ with eight changes of zero, or $0''.39$ with four only. It is remarked that as these figures closely coincide with those previously reached in Cape Colony and Natal with the same instrument, they probably represent the highest possible degree of precision attainable under the special climatic conditions and with the instrumental means available. So far as the observing end of each line is concerned this is possibly true, but it is questionable whether the results might not have been improved, with no sacrifice of time or money, if a better pattern of beacon had been employed. The tripod or quadripod beacon, forming from any distant point a double cone, with vertex at the centre, of sufficient height to enable the theodolite or heliostat to be centred without disturbing the legs, is an altogether preferable form to the pole beacon actually used.

E. H. H.

[1] Geodetic Survey of South Africa. Vol. v. Reports on the Geodetic Survey of the Transvaal and Orange River Colony, executed by Colonel Sir W. G. Morris, K.C.M.G., C.B., and of its connection by Capt. H. W. Gordon, R.E., with the Geodetic Survey of Southern Rhodesia, with a preface and introduction by Sir David Gill, K.C.B., F.R.S. Pp. xxxvii+463+16 plates; 6 maps. (London: Harrison and Sons, 1908.)

NOTES.

Dr. S. F. Harmer, F.R.S., has been appointed, subject to confirmation, keeper in zoology at the British Museum (Natural History), South Kensington. Dr. Harmer has been superintendent of the Museum of Zoology at Cambridge since January 1, 1892. He is a fellow of University College, London, and lecturer in natural sciences at King's College, Cambridge. Dr. Harmer is joint editor of the "Cambridge Natural History," and he has written numerous scientific papers dealing mainly with the Polyzoa. He has also done much to elucidate the affinities of the obscure organism Cephalodiscus with some of the more primitive members of the great group Chordata, which includes the vertebrates. He was president of the zoological section of the British Association at the recent meeting in Dublin, and is a past-president of the Museums Association.

It is announced by the *Daily Chronicle* that the Nobel prize for medicine will this year be divided between Prof. Metchnikoff, assistant director of the Pasteur Institute of Paris, and Dr. P. Ehrlich, director of the Royal Institute of Experimental Therapeutics at Frankfurt-on-Main.

Mr. N. W. Thomas has been selected by the Secretary of State for the Colonies to conduct an investigation into the laws and customs of the native tribes of southern Nigeria. The tribes to be studied are, in the first instance, those of the old kingdom of Benin, but it is probable that the inquiry will be continued and include the natives of the other West African colonies in addition. Mr. Thomas is leaving to take up his duties in a few weeks.

The jubilee of the Geologists' Association will be celebrated on Friday, November 27, by a conversazione at University College, Gower Street, W.C. A number of interesting objects will be exhibited, and short lectures will be given by Prof. E. J. Garwood, on "In the Himalayas around Kangchenjunga," and by Mr. G. W. Young, on "Reminiscences of Association Excursions."

By the will of the late Prof. H. C. Vogel, who died in August, 1907, the Berlin Academy of Sciences has received, we learn from the *Revue scientifique*, a legacy of 17,000 marks for the purpose of awarding medals intended to encourage research work in astrophysics and spectrum analysis. From the same source we note that a prize of 2500 marks has been awarded to Prof. Abegg, of Breslau, for his physicochemical studies of gallium.

The first general meeting of the Concrete Institute was held on November 19 at the Royal United Service Institution, Westminster. Sir Henry Tanner, I.S.O., principal architect to H.M. Office of Works, a vice-president of the institute, occupied the chair. The institute started with 100 founders, and now has a list of more than 300 members. The Earl of Plymouth is the first president of the institute, the objects of which may be summarised as follows:—to advance the knowledge of concrete and reinforced concrete, and direct attention to the uses to which these materials can be best applied; to afford the means of communication between persons engaged in the design, supervision, and execution of works in which concrete and reinforced concrete are employed (excluding all questions connected with wages and trade regulation); to arrange periodical meetings for the purpose of discussing practical and scientific subjects bearing upon the application of concrete and reinforced concrete, and to conduct such investigations and to issue such publications as may be deemed desirable. In a preliminary statement, Mr. Edwin O. Sachs, chairman of the executive, said it is hoped that British public authorities concerned may find it advisable to contribute in some way towards the expense of the research work necessary in connection with concrete and reinforced concrete. In America the United States Government has already contributed 25,000*l.* for research work in this direction, while the German authorities have contributed 20,000*l.* towards research in reinforced concrete alone. Mr. C. F. Marsh, assistant engineer to the Metropolitan Water Board, then read a paper on the composition and uses of plain and reinforced concrete.

The habits and bodily pose of the sauropod dinosaurs, and more especially Diplodocus, form the subject of a very interesting paper by Dr. O. P. Hay in the October issue of the *American Naturalist*. In place of being mammal-like in carriage, the author is of opinion that these reptiles were built more like crocodiles, and, instead of walking, were consequently able only to crawl on land, and that perhaps slowly and laboriously. On the other hand, they were eminently amphibious, and capable of swimming easily. The great weight—some twenty tons—of these creatures would, according to Dr. Hay, inevitably lead to their being mired if they walked on land in quadruped-fashion, while the idea of their raising themselves on the hind-limbs is regarded as preposterous. Their food doubtless consisted of floating, and perhaps also submerged, water-plants, the latter of which could be readily reached by means of the long neck. In the case of Diplodocus, with its weak teeth, the chief nutriment may have been formed by masses of floating alga of the Chara type.

Dr. Hay communicates a second paper on dinosaurs to the Proceedings of the U.S. National Museum, in which he deals with the carnivorous group, discussing the nomenclature of certain forms, and directing special attention to the skull-structure of *Ceratosaurus nasicornis*.

We have to acknowledge the receipt of a large budget of papers published in the Proceedings of the U.S. National Museum. In one of these (No. 1635) Mr. J. O. Snyder describes a number of new fishes from Japan and the Riu-kiu (Liu-kiu) Islands, while in a second (No. 1643) he discusses two rare Californian fishes. American moths form the subject of papers by Mr. A. Busck (No. 1644) and Mr. W. D. Kearfott (No. 1649), the mosquitoes of tropical America are discussed in No. 1632 by Messrs. Dyar and Knab, and new neotropical Acrididæ are described by Dr. J. A. G. Rehn in No. 1650. Crinoids form the subject of two contributinns (Nos. 1634 and 1636) by Mr. A. H. Clark, in the first of which the axial canals of recent pentacrinids are discussed, while the arm-joints of that group and the comatulids are considered in the second.

The greater portion of *Naturen* for November is taken up with a memoir of the great pioneer geologist Leopold von Buch, with special reference to the fact that the present year is the centenary of the completion of his visit to Scandinavia. Von Buch, who was born in 1774, spent two years in a geological exploration of Norway, bringing his tour to a close on November 12, 1808, on which day he left the country.

Horse-breeding in America forms the subject of an article by Mr. J. G. Speed in the November number of the *Century Illustrated Magazine*. Special attention is directed to the Denmark and Kentucky breeds, the latter being regarded as unusually well fitted for campaigning purposes, for which it is now generally admitted that the English thoroughbred is unsuited. The paper is illustrated by portraits of a number of notable horses.

INHERITANCE in biology forms the subject of an address delivered by Mr. Angel Gallardo before the Instituto de Enseñanza General at Buenos Aires. Of this address, which has been published in the *Biblioteca* of that institution, we are indebted to the author for a copy. In the same cover is bound up a reprint of a paper by Mr. Gabriel, published in the *Comptes rendus* of the Paris Academy of Sciences under the title "Sur l'Épruve statistique de la Loi de Mendel."

THE Transvaal Museum, according to the report for 1906–7, is making strenuous efforts to obtain a representative collection of the animals of South Africa, both for exhibition and for study purposes. Already the exhibited series of antelopes is complete, with the exception of three species, although a few old specimens require replacing by better examples. The aim of the authorities goes, however, much beyond this, and efforts are to be made, with the aid of trained collectors, to institute a biological survey of the country, in the hope that new species and races may in the future be described locally instead of in Europe or America.

To the *Afhandlinger* of the Bergens Museum Aarbog for 1908 Mr. J. A. Grieg contributes the first part of an article on the Pleistocene fauna of Norway, dealing in this instance with the red deer, of which a number of antlers are figured. The author regards these Pleistocene red deer as practically identical with the existing Norwegian race, and this in turn as inseparable from the Scottish animal. In regard to the latter point, he writes as follows:—"The existing Norwegian red deer accords in most respects with the Scottish deer. As already pointed out, it cannot have travelled from Scotland to Norway by way of a land-bridge; and the resemblance between the two forms must accordingly be attributed to the similar physical conditions obtaining in their respective habitats, both of which possess a mild and moist climate on the coast."

THE results of a study of the weights of developing eggs, by Messrs. Ritter and Bailey, are recorded in vol. vi., No. 1, of the Zoological Publications of the University of California. The eggs of the Californian mud-fish (*Fundulus parvipinnis*) formed the subject of experiment, and it was found that during development they lost perceptibly in weight. This diminution appears to "have been due to carbon dioxide and organic salts representing the albuminoid loss, which had passed out through the egg-membrane and been washed away in the sea-water." It is suggested that weighings of large holoblastic eggs of amphibians might be advantageously compared with the weights of meroblastic eggs of allied species.

FROM a long series of papers in the Proceedings of the Indiana Academy of Science for 1907 we select for brief notice one by Mr. D. M. Mottier on the history and control of sex. After a long survey of the various views which have been suggested to explain the development of sex in the germs of animals and plants, the author rejects as untenable the theories that either nutrition or environment is the inducing cause of the differentiation. On the other hand, he appears to regard with more favour the hypothesis as to sex being pre-determined in the germ-cells, and consequently a matter of heredity. According to this view, certain parts of the hereditary substance of chromatin contain only male and others only female characters or determinants. If the determination of sex be a problem of heredity, and hereditary phenomena are connected with a physical basis, a theory of the foregoing nature is regarded by the author as worthy of fuller investigation.

To the seventh number of the *Bulletin International de l'Académie des Sciences de Cracovie* for 1908, Mr. M. Siedlecki communicates a preliminary note on the structure, habits, and development of the so-called flying-frog (*Rhacophorus reinwardti*) of Java. The sexes differ, it appears, in size, the female being one-third larger and twice as broad as her partner, while she is further distinguished by the smaller development of her voice-organs and somewhat less brilliant colouring. By means of sucking-organs, which are different in structure from those of Hyla, these frogs are able to ascend and cling to vertical tree-stems. The author confirms Wallace's statement as to the webbing of the toes serving the purpose of a parachute during a fall from a height. On such occasions the toes are extended and the limbs held close to the sides of the body, so as to increase its superficies, with the result that what would otherwise be a vertical descent is converted into a spiral course.

THE vitality of trawl-caught fishes, with special reference to their potential survival in aquariums connected with biological investigations, forms the subject of a paper by Dr. A. T. Masterman, issued as No. 42 of *Publications de Circonstance* by the Permanent International Committee for the Exploration of the Ocean. A second publication by the same body is the second volume (dealing with the year 1905) of a statistical bulletin of the marine fisheries of the various countries of northern Europe. The values of the commoner kinds of fish taken in each country during the year in question are set out in one set of detailed tables, printed in English and German on alternate pages, and the quantities in a second set. The largest item in the British Isles is 1,343,080*l*., yielded by the Scots herring-fishery, next to which comes the English catch of haddock, with a value of 1,329,537*l*.

A STUDY of cell structure in Porphyra, contributed by Miss S. M. Wislouch to the *Bulletin du Jardin Impérial Botanique de St. Pétersbourg* (vol. viii., part iv.), deals with the structure of the nucleus and the chromatophore with its prominent embedded pyrenoid. An account is also furnished by Mr. G. A. Nadson of bacteria identified in samples of mud taken from the bottom of Lake Ladoga.

THE connection between forests and rainfall is argued from a somewhat original standpoint in an article contributed to the *Indian Forester* (October). Transpiration of water from a forest is computed to be six hundred times the amount evaporated from a water surface of the same area. Calculating the proportion of land to water on the surface of the globe as 1 to 3, and reckoning that forest occupies one-quarter of the land, the moisture given off by forests is many times greater than that evaporated by the whole water surface. Hence it is reasoned that diminution of forest areas must lead to diminished rainfall, or, regarded conversely, the moisture which may be condensed to rain is primarily dependent upon the extent of forests.

THE chief feature in the lime fruit industry of Dominica, as stated in the report for 1907–8 on the botanic station and agricultural school, has been the large increase in the export of citrate of lime. Vigorous efforts are being made to improve cocoa cultivation on the island by demonstrating the use of manures on experimental plots and the value of grafted plants. The data recorded for the experimental trials of manures provide facts regarding the general action of certain ingredients besides proving the

positive value of manures for cocoa. A comparison of rubber yielded by Castilloa and Hevea trees points to the superiority of the latter both as to quality and facility of preparation, but the Hevea demands shelter from gales. It is mentioned that clusters of dates were obtained for the first time from trees introduced some years ago.

IN the course of a lecture reported in the *West Australian* (September 21) upon the adaptation of plants to their environment, Dr. A. Morrison refers to some of the modifications displayed by West Australian xerophytes. *Calythrix flavescens* and *Nuytsia floribunda* are mentioned as examples of extensive root development, where, however, the main roots run horizontally, while the smaller roots dip downwards. In the dry north-west, where trees are scarce, the few growing there are protected either by a thick cork or a smooth, white bark. *Eragrostis eriopoda*, a grass, is remarkable for the excessive hairy covering on the leaf sheaths, and *Poa nodosa* is characterised by the formation of bulbous swellings at the base of the stem.

MESSRS. F. E. BECKER AND CO. have issued a series of lantern-slides, prepared from botanical photomicrographs, that will interest teaching botanists who make use of the lantern for lecture purposes. Among the first series of fifty slides are sections of stems, roots, and leaves of phanerogams, mostly illustrating regular structure, but a few specimens of irregular structure, as exemplified by Calycanthus, Strychnos, &c., are included. The sections of fossil plants from the Oldham Coal-measures are likely to meet with the largest demand. The slides of *Zygopteris petiole* and Heterangium stem provide very good representations, being in some respects superior to the other specimens that have been examined.

THE reports of the sugar-cane experiments in the Leeward Islands for the year 1906–7 are full of interest, especially to those who have followed the course of the experiments that have extended over several years. Turning to the trial of different varieties, it is clear that considerable advantage will be derived from the introduction of new seedlings. So far, the introduction of new seedlings into plantations has proceeded more rapidly in St. Kitts, owing to certain circumstances detailed in the report. Another feature that has become more marked as the series of experiments has lengthened lies in the suitability of different canes for Antigua and St. Kitts. Thus Sealy Seedling provides the best record for the heavier soils of Antigua, while B. 208 heads the list for St. Kitts. The difference is only partially due to the soil, as the climatic conditions in St. Kitts are also more favourable to B. 208, that matures early, but is susceptible to drought. The varying yield of cane per acre, the quality of the juice, immunity to disease and other characteristics furnish data for discrimination of the varieties.

PLANKTON workers in general will welcome an addition to the somewhat sparse literature dealing with that interesting and difficult group, the Peridiniales, in a report on the Peridiniales of Danish waters, by O. Paulsen, issued from Copenhagen in the *Meddelelser fra Kommissionen for Havundersøgelser* (plankton series). The report is in English, and deals in a masterly way with identification keys to the various sections of the group. The figures and descriptions given of the various genera and species are apt, and likely to be of great use to observers who make identifications from preserved specimens. The bibliography appended is extensive and up to date. The section on the genus Ceratium is worthy of commendation on account of its careful treatment of this very variable section of the Peridiniales. The descriptions and figures of species suggest the great need of cultural treatment of a genus, the growth forms of which tend so strongly to break down specific limits.

STUDENTS of the occult will welcome the elaborate paper by Dr. W. L. Hildburgh in the current issue of the Journal of the Royal Anthropological Institute on Sinhalese magic. He illustrates with copious detail the equipment of the magician, devil-dancer, and astrologist, describes their methods, and provides an ample supply of curious charms, amulets, and horoscopes. He does not enter upon the question of the origin of this system of magic. Probably, as is the case with its religion, Ceylon is indebted for most of its magical lore to the neighbouring peninsula of India.

IN the October number of *Man* Father W. Schmidt throws new light on the disputed question of totemism in Fiji. He points out that there is a fundamental distinction between principal and secondary totems, the former being always double, an animal or a tree, both of which are protected by a rigid tabu; the latter consisting of various products used for food, as the yam, taro, or banana, which may be eaten, but only under specially defined conditions. He also discusses the relationship of totemism in Fiji to that of certain Australian tribes, like the Arunta. In both these regions we find a great number of plant totems; totemism is closely connected with magic, especially with rites intended to produce abundant crops; in both countries it is associated with conception and child-birth; and in both we find localisation of totems. It is worth noting, also, that while in North Australia the tabu is confined to the eating, in South Australia it extends to the killing of the totem. In this respect the system in Fiji resembles that of the northern Australian tribes.

IN the current issue of the Journal of the Royal Anthropological Institute Dr. C. S. Myers sums up his conclusions on the investigation of the races of Egypt. The current view is that from time immemorial there have always been at least two races in Egypt, the one Caucasian (Mediterranean) and the other Negroid, and that to this day both races are present throughout the country, though prevalent in different degrees in different regions. In opposition to this, Dr. Myers holds that every province contains a homogeneous population, notwithstanding that the mean measurements vary in degree of "negroidness" according to province, and that there is no anthropometric evidence of duality of race. Hence he concludes that the Egyptians were always a homogeneous people, who varied now towards Caucasian, now towards negroid characteristics, according to their environment, "showing such close anthropometric affinity to Libyan, Arabian, and like neighbouring peoples, showing such variability and possibly such power of absorption, that from the anthropometric standpoint no evidence is obtainable that the modern Egyptians have been appreciably affected by other than sporadic Sudanese admixture." In support of these novel and valuable conclusions he provides a copious statistical apparatus.

A NOTE by Maud DeWitt Pearl and Raymond Pearl, of the Biological Laboratory of the Maine Experiment Station, on the relation of race crossing to the sex-ratio appeared in the September issue of the *Biological Bulletin*. Some breeders have held that hybrids exhibit an excessive proportion of males, and the authors have examined the birth statistics of Buenos Aires with the view of testing this belief. It appears that during the

ten years 1896–1905, crossed marriages, in which the father returned his nationality as Italian or Spanish and the mother gave her nationality as Argentine, did give a slightly larger proportion of male births than pure matings in which both parents were Argentine, Italian, or Spanish respectively. The differences are not great, the numbers of male births per 1000 female births ranging from 100·8 for the marriages between Italians, 103·3 for those between Argentines, and 105·0 for those between Spaniards, to 105·7 and 106·7 for the crossed matings; on the number of births used the differences exceed, however, twice the probable error in every case except one. As the authors very truly state, vital statistics notoriously abound in pitfalls, but they conclude that preponderance of males observed appears not to be capable of explanation as the result of environmental or demographic influences.

IN the November number of the *Popular Science Monthly* (New York), Prof. A. E. Kenelly returns to the subject of the relation between record times and distances for different races, using as fresh illustrations the records of the Olympic Games held in London last July. In his original memoir, of which a notice appeared in NATURE for March 14, 1907 (vol. lxxv., p. 463), Prof. Kenelly showed that a linear relation subsisted between the logarithm of the record time for a race over a course of given length and the logarithm of that length. The Olympic records give points on the diagram lying close to, but above, the line determined by earlier records, the times being in every case relatively high. The divergence is most conspicuous in the case of the Marathon race, but this is not unnatural, as the conditions were scarcely similar to those of a race run over an artificial and almost strictly level course. Prof. Kenelly argues that records would be most easily beaten by the racer attempting to maintain until near the finish a uniform speed, equal to the average speed corresponding to the existing record, and suggests a mechanical method of pace-making for attaining this end.

THE English edition of the "Report of the International Meteorological Conference at Innsbruck, September, 1905," has been published recently by the Meteorological Committee. The work extends altogether to 156 pages, and has been excellently translated from the original German edition by Mr. R. G. K. Lempfert. The conference was attended by fifty-six gentlemen (including a few guests), several of whom represented organisations outside Europe. Some forty items for discussion were included in the provisional programme; some of these were referred to special commissions, while a few were ruled out as being of a purely theoretical character. An account of the opening and second and third meetings appeared in NATURE of September 21 and October 5, 1905 (vol. lxxii., pp. 510, 562). Among the matters subsequently dealt with we may mention a proposal by M. Durand-Gréville for the special study of squalls (hail, thunderstorms, &c.); a permanent commission was appointed to organise the observations. Thanks were accorded to MM. Hellmann and Hildebrandsson for the preparation of the International Meteorological Codex, a systematic collection of the resolutions passed at various meetings since 1871. The comparison of standard barometers, which had engaged the attention of previous conferences, was advocated, both for European and other stations. The magnetic commission also advocated a comparison of instruments and prompt exchange of records for disturbed days. Sir Norman Lockyer read the reports of the solar commission at Cambridge (1904) and Innsbruck (1905); observations are required, *inter alia*, at a number of island stations (specified) for all oceans. All the resolutions of the cloud commission, containing desired improvements in definitions, &c., were adopted by the conference without discussion.

A TWELFTH edition of Mr. Andrew Jamieson's "Elementary Manual of Steam and the Steam Engine" has been published by Messrs. Charles Griffin and Co., Ltd.

MR. C. BAKER, 244 High Holborn, has just issued a revised edition of his catalogue of microscopes and accessory apparatus. The catalogue includes particulars of a number of new instruments of interest to workers in microscopy, whether they be students, teachers, naturalists, or men concerned with studies in medicine or public health. The list of lantern-slides also includes many sets of interest.

THE fourth edition of Behrens's "Tabellen zum Gebrauch bei mikroskopischen Arbeiten" (Leipzig: S. Hirzel, price 8 marks) has been received. It contains tables of weights and measures, specific gravities, solubilities, and formulæ of fixing and hardening agents, stains, microchemical reactions, &c., and should prove of the greatest service in biological, bacteriological, and pathological laboratories.

A SECOND edition of "British Mosses," by Sir Edward Fry, G.C.B., F.R.S., has been published by Messrs. Witherby and Co. With one exception, the illustrations in the new edition have been re-drawn; the short treatment of the liverworts, which formed part of the earlier issue, has been omitted, since the author hopes shortly to deal with this group in a separate volume. The price of the book is 1*s*. 6*d*. net.

MESSRS. W. HEFFER AND SONS, Cambridge, have published a second edition of Mr. Sydney W. Cole's "Exercises in Practical Physiological Chemistry." The first edition of the book was reviewed in NATURE of March 2, 1905 (vol. lxxi., p. 412). It is sufficient to point out that the chief changes are the adoption of the new nomenclature for the proteins as recommended by the Physiological Society, a new set of exercises on the globulins of blood serum, and new methods for the quantitative estimation of sugar.

THE Iron and Steel Institute has published separately an excerpt from its Journal (No. 3 for 1908) dealing with the visits and excursions at the Middlesbrough meeting this year. The report, which is edited by Mr. L. P. Sidney, the assistant secretary of the institute, provides a brief *résumé* of the proceedings at the Middlesbrough meeting, the speeches at the various functions, accounts of visits to places of interest in the neighbourhood, and descriptions of the various steel and iron works visited by parties during the Middlesbrough meeting. The booklet will serve as an interesting memento of a successful meeting.

THREE books of especial interest to those connected with the tropics are shortly to be published by Messrs. J. and A. Churchill. They are:—"Report on the Prevention of Malaria in Mauritius," by Prof. Ronald Ross, C.B., F.R.S.; a new volume of "Studies from the Institute of Medical Research," issued by the authority of the Government of the Federated Malay States; and "Lessons on Elementary Hygiene for Especial Use in Tropical Climates," by Dr. W. T. Prout, C.M.G. The eighteenth edition of Squire's "Companion to the British Pharmacopœia" is also announced by the same firm.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN DECEMBER :—

Dec. 2. 2h. 11m. Saturn in conjunction with the Moon (Saturn 2° 56′ N.).

7. 9h. 55m. Middle of penumbral eclipse of the Moon visible at Greenwich.

,, 11h. 32m. Occultation by the moon of 105 Tauri (mag. 5·8), reappearance 12h. 43m.

,, 17h. 36m. Occultation by the Moon of η Tauri (5·2), reappearance 18h. 21m.

8. 10h. 58m. Occultation by the Moon of ι Geminorum (4·3), reappearance 12h. 13m.

9. 19h. 2m. Neptune in conjunction with the Moon (Neptune 2° 38′ S.).

13. 14h. 37m. Occultation by the Moon of i Leonis (5·7), reappearance 15h. 44m.

14. 10h. 47m. Jupiter in conjunction with the Moon (Jupiter 4° 22′ S.).

17. 17h. 50m. Occultation by the Moon of 80 Virginis (5·8), reappearance 18h. 53m.

19. 13h. 56m. Mars in conjunction with the Moon (Mars 2° 58′ S.).

20. 12h. 37m. Venus in conjunction with the Moon (Venus 0° 56′ S.).

22. 23h. 49m. Eclipse of the Sun. Invisible at Greenwich.

24. 0h. 39m. Uranus in conjunction with the Moon (Uranus 1° 25′ N.).

25. Comet Morehouse (1908*c*) in perihelion.

29. 8h. 14m. Saturn in conjunction with the Moon (Saturn 3° 4′ N.).

MOREHOUSE'S COMET, 1908*c*.—Its declination having become southerly on November 22, and its R.A. being within $2\frac{3}{4}$ hours of that of the sun, comet Morehouse is now becoming a more difficult object to find, and this condition has been considerably aggravated, in town, during the past fortnight, by the haziness of the sky between sunset and midnight. The comet now sets below the horizon of London at about 8.15 p.m.

A continuation of Dr. Ebell's ephemeris, prepared by Dr. Smart, appears in No. 402 of the *Observatory* (p. 422, November), and shows that, after its perihelion passage, the comet will never rise above our horizon from about the middle of January until the middle of May, 1909.

The greatest southerly declination, 80°, will be attained about March 24, and during its period of visibility the comet will have practically travelled from pole to pole. According to the ephemeris, its apparent brightness is now decreasing slowly, but will not fall below that at the time of discovery until the end of April.

A second set of elements and a new ephemeris have been prepared by Messrs. Einarsson and Meyer, of the Berkeley Astronomical Department, and are published in No. 139 of the Lick Observatory Bulletins; the ephemeris extends to December 28·5.

HALLEY'S COMET.—A search-ephemeris for Halley's comet, published in *Popular Astronomy*, gives the position for November 27 as 6h. 21m. 18s., +11° 15′ 17″, and shows that the R.A. is at present decreasing at the rate of about 44s. per day, whilst the declination is decreasing by about 30″ per day. On November 27 the calculated distance of the comet from the earth will be about 5·26 astronomical units.

According to Mr. Wendell, the radiant point of the meteors from Halley's comet is R.A. = 22h. 43m., dec. = +1° 18′, and it is suggested (the *Observatory*, No. 402) that meteors should be looked for from this radiant about May 12 during the next three years.

In anticipation of the return of Halley's comet and the increase of our knowledge of comets that is likely to result therefrom, the Astronomical and Astrophysical Society of America has appointed a committee to organise the proposed observations, so that the most useful results may be obtained.

A SIMPLE INSTRUMENT FOR FINDING THE CORRECT TIME.—In the November number of the *Bulletin de la Société astronomique de France* (p. 483) Prof. S. de Glasenapp gives an illustrated description of a very simple apparatus by which the true time may be determined with wonderful precision.

The device is called the *cercle solaire*, and consists of a metallic cylinder, about 4 inches in diameter and half an inch in height, so suspended that a diameter always hangs vertically, and so that its direction in azimuth may be fixed. A conical hole is drilled through one wall of the cylinder at a point 45° from the top, the smaller end of the hole being directed towards the centre.

The method employed is really that of equal altitudes before and after the meridian passage, and the sunlight passing through the conical hole forms a "disc" image on an arbitrary scale marked on the interior wall of the cylinder. To find the error of a watch, the times at which the solar image transits, or is tangent to, or symmetrical with, the same scale marks before and after midday are noted, and by a suitable reduction of the observations the time, by the watch, of actual solar noon is found. Applying the corrections for the equation of time and the difference of longitude, if any, the actual mean time is obtained.

The instrument has been rigidly tested at the St. Petersburg Observatory, and the results show that the true time may be obtained within forty seconds even when the change of the sun's declination is neglected; if the latter be taken into account, the reduction necessarily becomes a little more complicated, but results correct within one second may be obtained.

EPHEMERIS FOR JUPITER'S EIGHTH SATELLITE.—A new set of elements and an ephemeris for the eighth satellite of Jupiter, calculated at the Berkeley Astronomical Department, appear in No. 140 of the Lick Observatory Bulletins. The ephemeris gives the distances, in R.A. and declination, between the satellite and Jupiter until December 2. The period of the satellite, according to the new elements, is 2·2948 years.

DESIGNATIONS OF RECENTLY DISCOVERED VARIABLE STARS.—No. 4278 of the *Astronomische Nachrichten* contains the final designations of fifty-three variable stars discovered during 1907, as fixed by the Commission for the A.G. Catalogue of Variable Stars. The table also contains the provisional number, the position (1900), the precession (1900), and the range of magnitude of each star, and is followed by numerous notes dealing with the peculiarities of many of the variables.

THE ENUMERATION OF MINOR PLANETS.—The permanent numbers for recently discovered minor planets (1907–8) are given by Prof. Bauschinger in No. 4278 of the *Astronomische Nachrichten*. The increase, during the past few years, of the number of these objects known is shown by the fact that the permanent number for 1908 C.S. is 659.

THE VARIATION OF LATITUDE.—In reducing the international latitude observations it is assumed that the individual variations, in a definite interval of time, are equal, whatever star pairs be used, and in order to test the validity of this assumption Mr. Hirayama has examined the results of the observations for the period 1900–4. The results of his research appear in No. 4281 of the *Astronomische Nachrichten* (p. 133, November 7), and show that the variation of latitude deduced from each individual pair deviates more or less in a systematic manner. It is also shown that the amplitude of the z variation depends to some extent upon the zenith distance, the brightness, and the difference in right-ascension of the pair of stars observed.

THE FOREST REGION OF MOUNT KENIA.

KENIA is the only snowy mountain in the Old World lying exactly on the equator. Its height is 17,150 feet; it has fifteen glaciers, and the snow-line is there somewhat lower than to the north and south, where there is more variation of season. Kenia is the culminating point of the richest part of British East Africa. The Kenia snows can now be reached in little more than a month from England by way of Mombasa and the Uganda Railway. Mr. E. Hutchins (chief conservator of forests) and Mr. Ross (director of public works in British East Africa) recently returned from a tour round the Kenia forest and a visit to the glaciers.

Quite recently the Pax Britannica has been extended completely round Kenia, though a portion of the route traversed by Hutchins and Ross was through country ranked until then as hostile, that is to say, the Mwèru country, lying on the eastern side of Kenia. A special escort was provided, and no hostility of any kind was experienced. The route followed comprised a journey completely round Kenia, and almost the whole time in the Alpine region at an elevation of about 12,000 feet. Two months was spent in the journey round Kenia. The object of the expedition was to ascertain the exact extent and value of the great forest girdle which stretches round Kenia. For this purpose it was found most convenient to travel at an altitude of about 12,000 feet in order to avoid the tussock grass, which extends above the upper forest limit, and is a serious impediment to progress in the open Alpine country. The tussock grass of Kenia grows in bunches 3 feet or 4 feet high and 3 feet or 4 feet through, and when, in the wet season, it is covered with half-frozen rain and hail, progress through it is not easy. Above the tussock is a zone of shorter grass, with a sufficient supply of firewood in the trunks of the giant heath. This tree, *Erica arborea*, marks the upper limit of tree growth on the Kenia Mountain.

Four glaciers on the western side were visited, and found much as described in Mr. Mackinder's account of their condition nine years ago. Scenes of extraordinary Alpine beauty were traversed, and Mr. Ross obtained a series of photographs, which it is hoped may soon be published. He had charge of the triangulation which determined the boundaries of the forest, and he traversed all but a small portion of the Alpine region.

A number of weather observations were made, the chief feature of which was a persistent high-level north-east current at an altitude of about 20,000 feet. On Kenia Mountain, between elevations of 7000 feet and 14,000 feet, the atmosphere was singularly calm and serene. The general air movement was towards the central snowy peak by day and off it by night, exactly the reverse of what one would have expected in the case of a cool, damp, forest-clad mountain surrounded by dry, sun-scorched plains. Below 7000 feet elevation, and on the plains away from the mountain, the south-east trade wind blew strongly by day from the south and east. On the northern highlands, at about 10,000 feet elevation, the climate was curiously mild and equable. It was not only pleasant and healthful, but extraordinarily exhilarating. There was little or no frost at night, and the small quantity of rain that fell came mostly at night, while by day the equatorial sun was almost invariably screened by a thick mantle of cloud. This great uninhabited plateau, so singularly beautiful, so eminently a white man's country, suggests itself naturally as the site for the future capital city of the British possessions in mid-Africa—the Bogota of the Old World!

The whole of the Kenia Alpine region is healthful and invigorating, but there is a great contrast, during at least half the year, between the wet and misty southern slopes of Kenia and the dry, bracing plateau country of northern Kenia. The expedition consisted of three white men and about fifty natives, and, with the exception of a few cases of lung trouble among the coast natives, there was no sickness, in spite of hardships which, in a less favourable climate, would have told immediately. Hail was experienced on numerous occasions; in fact, on the wetter southern side of the mountain there was a severe hailstorm daily. A real snowstorm was experienced on one occasion only. Then the snow fell in light flakes exactly like a snowstorm in extra-tropical latitudes. This snowstorm lasted for some hours. For some miles, too, around the glaciers a light mantle of snow covered the ground, but this rapidly melted under the influence of a little sun and the warmer air which was experienced at higher altitudes during the day. Kenia peak was bare of snow on the north-eastern side, presumably on account of this comparatively warm upper current. These observations have a peculiar value, since they were made at the wettest time of the year—April, May, and June. The weather on the southern side of Kenia was at this season a striking contrast to what Mackinder and Hausberg experienced. During the wet season, April and May, Hutchins and Ross found the southern side at Alpine altitudes dripping with moisture, and the air nearly saturated with moisture the greater portion of the time. There was a small portion of the southern side of the mountain which was too wet for the upper traverse, and the forest there had to be inspected and mapped from below only.

Everywhere else the forest was examined from above and below, and linear sample areas of the timber measured. The forest belt that encircles Kenia had been reported to be interrupted on the northern side. This was found not to be the case. It is practically continuous right round Kenia. There is, indeed, a small break on the north-west side, but so small as to be scarcely worth mentioning. This break was barely eight miles long, little more, in fact, than the average width of the forest belt, which was found to vary from six to nine miles in breadth. On the northern and western sides, where the forest belt was thinnest, the quality of the forest was the best, it being there largely composed of cedar, which is found in the drier forest only. In the magnificent reach of forest filling up the great south-eastern bay of Kenia, Ibean camphor was abundant, but here cedar is entirely absent, and the effective thickness of the forest belt on this side is reduced by a broad strip of bamboo, *Arundinaria alpina*. In the drier parts of the mountain the bamboo belt is much reduced in breadth; it is frequently broken, and sometimes absent.

The most valuable timbers in the Kenia forest are Ibean camphor on the wet south-eastern side, and cedar, *Juniperus procera*, on the drier western and northern sides. The former is no doubt a timber of exceptional value. Its botanical name has not yet been determined, its flower being now seen for the first time; but cedar is a loftier and far more abundant tree than camphor. It runs up in straight stems to heights of more than 100 feet, and a tree was measured (on northern Kenia) with a diameter of nearly 12 feet. It is extremely durable, and the forest was found richly stored, not only with the live timber of to-day, but with the dry and still sound timber of past ages. Fire does incalculable damage in these cedar forests. The most abundant timber in the Kenia forest is yellow-wood, *Podocarpus thunbergii*, var. *milanjianus*, a tree differing little from the widespread and well-known yellow-wood of South Africa. Another yellow-wood, *Podocarpus gracilior*, in stature and shape has been compared to the Kauri of New Zealand, but this yellow-wood is but sparingly represented. The finest timber is in the great south-eastern Bay of Kenia, but this is largely composed of hardwoods, which have not the same value as the camphor, and conifers. Altogether the expedition disclosed a forest of great value, and a particularly important asset to a young country such as British East Africa, without mineral wealth.

THE INTERNATIONAL FISHERY CONGRESS AT WASHINGTON.

THE fourth International Fishery Congress, which met in Washington on September 22, and adjourned *sine die* on September 25, is generally conceded to compare well with the high standards set by its predecessors in Paris, St. Petersburg, and Vienna. Although several of the more important fishery nations were not represented, the membership was truly international. About twenty foreign countries of Europe, Asia, North and South America, and Australasia were in attendance through delegates of Governments, scientific bodies, and fishery societies, and practically all the States of the United States were officially represented. Although the place of meeting and the preponderance of American membership tended to accentuate the American point of view, the strength and ability of the foreign delegation gave to the proceedings a catholicity of expression not always observable in international congresses.

The international regulations of the fisheries on the high seas was the subject of considerable discussion, three papers having that title being presented, respectively, by Mr. Fryer and Dr. Olsen, of England, and Mr. Stevenson, of Washington.

The recognition of the freedom of the seas by the stronger maritime Powers has been slow and grudging, and the crystallisation of the now recognised distinctions between international and territorial waters has been the growth of comparatively recent years. The conventions which have been entered into between nations respecting the regulation of the fisheries common to the subjects of the contracting parties have been surprisingly few considering the importance of the interests involved, though this is not surprising to those in a position to appreciate the biological, legal, and practical difficulties presented for solution.

These international fishery regulations fall into two classes, the one for the conservation of the resources of the sea, the other for the maintenance of order and the protection of life and property. Concerning the necessity for the latter there was not much difference of opinion, and, in fact, most of the accomplished fishery conventions between nations have been for these purposes. That the resources of the sea are in actual need of conservation through international agreement or the concurrent action of the maritime nations was by no means clear to many who took part in the discussion, though most were agreed that the fisheries for sessile organisms, such as sponges, corals and pearl oysters, or for whales, seals, and other marine mammals, were doomed unless means can be devised for the extension of protective measures beyond the present recognised limits of territorial jurisdiction.

It was contended with considerable force that in the case of sessile organisms (as distinguished from feræ naturæ) susceptible of culture involving actual occupation of the bottom, not only justice, but necessity, demands the extension of a restricted form of property right beyond the marine league from shore. The requirements of man have outrun the bounty of nature, and the barren bottoms covered by the high seas should no longer be permitted to go to waste. In other words, it was held that the present and future needs of mankind demand the extension to certain international waters of the measures which experience has shown to be necessary for the edible oyster within territorial limits.

The recent convention between the United Kingdom and the United States, looking to the enactment of concurrent legislation for the control of the fisheries in waters contiguous to the United States and Canada, was referred to with approval by speakers from both countries interested, and among the American participants in the discussion there was a surprising unanimity favouring Federal control of the fisheries in inter-State waters now subject to several State regulations.

In the field of aquiculture two very important papers were submitted by Prof. A. D. Mead. The first was a description of an apparatus for hatching, rearing, and transporting fishes and other aquatic animals. In this the great departure from former methods is that the hatchery is taken to the water rather than the water to the hatchery. It "consists essentially of creating and maintaining within an enclosure of 'native' water a gentle upward, swirling current" by means of propellers revolved through the medium of suitable gearing by a gasoline engine or other motor. The rotary currents set up by the propellers aërate the water, eliminate the toxic gases of respiration, and prevent the suffocation of the eggs and larvæ by their massing on the bottom and sides or through the deposit of sediment. For hatching and rearing the compartments or units, about 10 feet square, are mounted on suitable floats surrounded by the open natural waters, which maintain the cars at an equable optimum temperature. For transporting fishes the same principle is applied to receptacles packed in ice.

Prof. Mead's second paper was an exposition of the use of this apparatus in hatching and rearing lobsters. The artificial hatching of these crustaceans presents few difficulties, but, on the other hand, it possesses no very great advantage over the natural method. The heaviest mortality in this species is in the period of three or four weeks between the emergence of the young from the egg and the period when it assumes its bottom habit. During this time the larvæ are helpless and exposed to many enemies, and Dr. Mead's method is the only one yet proposed which permits the young to be reared to a stage where they can care effectively for themselves. Equally good results can be attained with various fishes passing through similar critical stages, and fish culturists now have in their possession an entirely new and simple method, not only for hatching fishes, but for economically rearing them in large numbers to an age when they can care for themselves. The method is a wide departure from those previously employed, and marks the greatest advance in fish culture within recent years. It may be added that it has for several years demonstrated its practical utility.

The "lobster question" in general provoked considerable debate, in which English, Canadian, and American representatives participated. Dr. Geo. W. Field proposed a radical departure in the regulation of this fishery, advocating the use of apparatus which will automatically exclude the large breeding lobsters from capture, while taking those between 9 inches and 11 inches in length, which produce few or no eggs. This proposal was strongly combated, especially by the advocates of artificial hatching, who contended that present methods are now resulting in an increase in the lobster catch, and that a change would prove disastrous.

Three papers by Messrs. Paul Reighard, Frank N. Clark, and S. W. Downing, on the subject of the promotion of white-fish production in the Great Lakes, while dealing with a fishery in which the United States and Canada only are concerned, precipitated a discussion of international interest. The three writers, reasoning along somewhat different lines, all reached the conclusion that artificial propagation offers the only feasible plan for increasing the white fish; that a close season during the spawning period is worse than futile, especially where there are offered facilities for taking and hatching eggs; and that closed seasons and restrictive measures should not be applied to the spawning fish, but to small and immature specimens. These propositions, while representing the preponderance of American opinion on the subject, met with vigorous opposition from Mr. Chas. E. Foyer, of England, and from several American delegates, while Prof. E. E. Prince, of Canada, doubted the practical feasibility of preventing the capture of small fish if fishing were permitted at all.

Dr. P. P. C. Hoek, of the Netherlands, presented a paper on the propagation and protection of the Rhine salmon. The Rhine is distinguished among the salmon streams of the Atlantic basin by its productiveness, and Dr. Hoek demonstrated that, as under existing conditions comparatively few salmon reach their natural spawning grounds, the present supply of fish is maintained principally by artificial propagation. To be effective, however, this must adhere in many particulars as closely as possible to nature's method; especially must the fry be planted in these upper waters in which the proper conditions exist for their year-long stay in fresh water. The loss sustained in the long downward run to sea must be compensated for by more extensive planting in the headwaters.

Bearing upon this question of the utility of fish culture, an interesting paper was presented by Mr. L. G. Ayson, of New Zealand, on the introduction of American fishes into New Zealand waters. New Zealand, though bountifully provided with rivers and lakes, presents the extraordinary characteristic of an almost total lack of freshwater commercial and sporting fishes. About twenty-five years ago three consignments of eggs of the steelhead trout, *Salmo gairdneri*, were planted, and the species artificially propagated, with the result that to-day they exist in extraordinary numbers in nearly all streams and lakes in the northern part of the country. The Chinook salmon, *Oncorhynchus tschawytscha*, was planted between 1901 and 1907, about two million eggs being imported. The first returns were in 1905, when a few were caught by anglers, and as there has been a spawning run each year since, it is believed that the species is now firmly established. Several other American fishes have been introduced into the waters of New Zealand, where they have become thoroughly acclimatised. The results of planting certain American Salmonidæ in Europe are well known, and recent experiments in carrying them to Argentine have been favourably reported on. Experiments in the acclimatisation of fishes, however, have not

always met with success. Certain lakes possessing all the obvious biological and physical requirements have been repeatedly planted without result, and it has been but recently determined, through the work of Prof. E. A. Birge, that the failure is due to peculiarities of the gaseous content of the water. In a paper on the gases dissolved in the waters of Wisconsin lakes, Dr. Birge illustrated his studies, which are of the highest value to fish culture.

A paper on the utilisation of sea-mussels and dogfish as food, presented by Dr. Irving A. Field, opened a very general discussion on a subject which appealed to both the biologists and the practical fishermen. During recent years the horned dogfish (*Squalus acanthias*) has been extremely destructive to fish and fishing on the coasts of Canada and New England, while the smooth dogfish (*Mustelus canis*) is a perennial menace to the lobster. In Canada oil and fertiliser works have been established for the purpose of supplying a market and encouraging the destruction of the dogfish, and Prof. Prince is of the opinion that they have to some measure decreased in numbers.

Dr. Field's experiments have demonstrated that the smooth dogfish, salted and dried, makes a product closely resembling the cod, and in a fresh condition it is not inferior in texture and flavour to halibut; the horned dogfish, being more oily, is better adapted for tinning. Mr. Fryer stated that the equally destructive dogfish of the English coasts had been placed on the markets by the fishermen, and while it was unobjectionable as to quality, it met with prejudice on account of its name, a difficulty which also confronts the exploitation of dogfish as food in the United States and Canada. An euphonious name, not deceptive in character, would assist greatly in converting a fishery menace into a valuable product and important source of cheap food supply. The practical difficulties confronting the utilisation of these fish are being made the subject of inquiry by various technical bodies in the United States and Canada.

A communication from the Rhode Island Commission of Inland Fisheries, in reference to the effects of gunfire on schools of fishes, developed a difference of opinion between the scientific men and the practical fishermen. The latter declared that the heavy detonations from cannon drive the fish away from the coast, but the results of experiments at Woods Hole, as recounted by Dr. Sumner, indicated that mackerel and other surface-living fishes were but little disturbed by either gun-fire or the noises made by boats using explosive engines. The investigations of Dr. Parker at the fisheries laboratory prove that certain fishes are influenced by sound stimuli as distinguished from the grosser mechanical vibrations of the water, but that their sudden movements of alarm are dictated by sight rather than by hearing.

Eighteen corporations and individuals interested in the fisheries offered prizes for contributions on special subjects, and of these seven were unawarded, either because the papers submitted did not satisfy the strict conditions of the award or because they did not conform to the standard of merit imposed by the international jury of awards. Two awards were made to Prof. A. D. Mead for the papers above-mentioned, two to Dr. H. F. Moore for papers on the sponge fisheries and on growing sponges from cuttings, one to Mr. Dwight Franklin for the best method of preparing fishes for museum purposes, one was divided between Dr. F. A. Lucas and Mr. R. W. Minor, for papers on the best plan for an educational exhibit of fishes, one was given to Mr. Chas. H. Stevenson for the paper above alluded to, one to Mr. Paul Reighard for the best plan to promote the white-fish production of the Great Lakes, one to Prof. Jacob Reighard for the best methods of observing the habits and recording the life-histories of fishes, one to Mr. Chas. G. Atkins for a paper on foods for use in rearing young salmonoids, and one to Mr. John J. Solomon for a process for preserving the pearl fisheries and increasing the yield of pearls.

Many papers of much practical and scientific merit were submitted, but not read for lack of time, but they will be published in the proceedings of the congress. The fifth congress will be held in Rome in 1911, the year of the semi-centennial of the Italian Federation.

PSYCHOLOGY OF PLEASURE AND PAIN.

THE last two numbers of the *Psychological Review* (July and September) have contained important articles by Prof. Max Meyer, of the University of Missouri, on the nervous correlate of pleasantness and unpleasantness. In the former the author brings out the contradictory character of the present views of psychologists on this subject, and in the latter proposes a theory that he believes accords with all known facts and gives proportionate weight to the various aspects of the question upon which his predecessors have dwelt too exclusively. The clearest opposition has hitherto been between the psychologists, who hold that pleasantness and unpleasantness are merely weak (and therefore badly localised or entirely unlocalised) forms of the sensations, which at a higher degree of intensity become respectively sexual sensation and pain, and those who, denying their substantive status, regard them merely as aspects or "tones" of sensational processes.

Prof. Meyer's theory is of a different type altogether, and is based upon the concept of an hierarchy of reflex arcs or a "centralisation by degrees." Let A and B be two sensori-motor systems of neurons relatively independent, but having at least one connecting neuron in common. It is always possible for these to merge into a more complex sensori-motor system, C. The marks of this higher organisation will be (1) that stimulation of a sensory point of either A or B may produce simultaneous reactions at motor points both of A and B; and (2) that simultaneous stimulation of sensory points of both A and B may produce a reaction at a motor point of A or B only. In the case of such a system, if the subsystem A is functioning a strong stimulation of subsystem B will produce a decrease in the intensity of the current in A (drawing it off, in fact, towards motor points of B), while a gentle stimulation of B will merely increase the current setting towards motor points of A. The decrease or increase in the flow through system A, due to the action of B, is the nervous event which will be experienced as unpleasantness or pleasantness respectively. For example, the slight degree of pain produced by scratching after an insect's bite is rather pleasant, for it actually increases the energy of the scratching process. If, however, the pain becomes too intense, its own typical reaction is set up; energy is drawn off from the scratching process, and unpleasantness is felt.

It follows on this theory that pleasantness and unpleasantness are attributes of the relatively more complex psychophysical functions, and, therefore, that their highest intensity may be expected to accompany intellectual activity—a result which the author claims as a powerful piece of evidence of the superiority of his doctrine over that which would regard them as "feeling tones" of sensations.

SCIENTIFIC EDUCATION OF NAVAL ARCHITECTS.[1]

IT has occurred to me that an appropriate subject for the address, which it is my duty to deliver as chairman of the council, may be found in a brief account of the methods adopted for the education of naval architects in this country during the past century. I venture to hope that, apart from its particular interest for those engaged in shipbuilding, the narrative may have some value and attraction for those interested in technical education generally, and that it may throw some light on problems of higher technical education which still await solution in this country.

In 1806 the Commission of Naval Revision reported in regard to the principal shipbuilding officers of the Royal Navy. There is evidence that outside the Admiralty service the standard of professional attainment amongst British shipbuilders was then low. As practical ship-carpenters they excelled; their ships were "well and truly built," strong and durable. As ship-designers they depended on

[1] From an address delivered before the Society of Arts on November 18 by Sir W. H. White, K.C.B., F.R.S., chairman of the Council of the Society.

precedent and experience. British warships were designed in accordance with "established dimensions," according to which ships of a certain tonnage carried a certain number of guns of specified sizes. The tonnage was estimated by an unscientific rule; and a competent authority, speaking of the condition of things existing at the beginning of the last century, asserted that "scarcely an individual in the country knew correctly even the first element of one of our numerous ships." As a matter of fact, the official "established dimensions" were varied but little from 1680 to 1810, and there was practical stagnation in British shipbuilding.

Instead of advance having been made in the practice of naval architecture in this country during the eighteenth century, there is reason to believe that there had been retrogression, so far as scientific knowledge and methods were concerned.

The movement in favour of better education for British shipbuilders and the adoption of scientific methods in ship design a century ago was chiefly due to men unconnected with the industry, and was not welcomed by shipbuilders of the older school. Fortunately, opposition from various quarters was overcome, and the first school of Naval architecture began its work at Portsmouth in January, 1811, under the direction of Dr. Inman, a distinguished graduate of the University of Cambridge. The intention was to train men who should unite sound practical experience with high scientific knowledge, to give them employment subsequently at sea and in the work of ship-designing, and so to provide efficiently for the higher ranks of officers at the Admiralty and in the Royal dockyards.

When the steam-reconstruction of the Navy had to be undertaken about fifty-five years ago, and was rapidly followed by the use of armour as a protection against attack by explosive shells, it became impossible any longer to pretend that naval officers, untrained as naval architects, could undertake the responsible work of designing British warships. Fortunately, trained men were available in the persons of Dr. Inman's old pupils, who had been compelled to wait twenty years before their opportunity came.

Sixteen years elapsed before a second school of naval architecture was established by the Admiralty at Portsmouth, under the title of the "Central School of Mathematics and Naval Construction." Five years earlier the Admiralty had framed a scheme for schools in the Royal dockyards, at which all apprentices were required to attend "every afternoon for three hours, commencing an hour and a half previous to that at which the yard closes." Under this rule the Admiralty paid the boys' wages for one-half the period of school attendance, and required them to give the other half out of their own time. Beginning with "elementary matters, such as reading, writing, common and decimal arithmetic, Scripture, English history, and geography," the apprentice passed on to more advanced instruction. At the end of three years a selection was to be made by means of an examination, and those whose abilities entitled them to a higher course of instruction were allowed to attend school for two years more. For the majority of apprentices this ended their education: but the Admiralty order provided that "two or three of the best apprentices in each yard should be elected to the first class, should be instructed in 'laying off' and the leading principles of ship construction, and, so far as it is necessary for that purpose, should be taught mechanics, hydrostatics, and mathematics." Its main features have been continuously maintained for sixty-five years, with results which more than justify any expenditure incurred. As the national standard of elementary education had been raised, so the required standard for the admission of apprentices had been elevated, and out of the dockyard schools there had come multitudes of well-educated, intelligent workmen, from amongst whom, by a process of gradual selection, had been found subordinate and principal officers for the Admiralty service, while no small number had passed from that Service into the private trade, and occupied positions of importance and responsibility in shipyards throughout the country and on the staffs of the registration societies for shipping, of which Lloyds' Register is the greatest. The scheme is broad and generous; it gives facilities and aid, while requiring apprentices on their side to study in time that would otherwise be their own for leisure or recreation. It carries on, side by side, practical and educational training; it exercises a gradual selection of those whose ability and application show them to be capable of benefiting by higher instruction. It sets up a "ladder of learning" from the lowest level, and there has been no bar to any capable man in striving to reach the highest position. Its cost is extremely moderate in proportion to its beneficial results. For the current financial year the dockyard schools at home and abroad are estimated to cost less than 0200*l*., while the wages vote for these establishments exceeds two and a half millions sterling.

The second school of naval architecture constituted the final stage in the Admiralty scheme for the technical education of its naval architects. Its students were intended to be the pick of dockyard apprentices of five years' standing, who during that period had received an excellent general education, a good training in the practice of shipbuilding, and a special course of mathematics bearing on naval construction. It differed from the first school, therefore, because the former institution had been intended exclusively for a higher class of apprentices, to whom appointments were guaranteed when their course of training was satisfactorily completed. In other words, the fundamental idea of the first school was to train students who were intended to become superior officers subsequently. On the contrary, the working apprentice class, by a process of selection applied at intervals during five years, was intended to supply the students to be trained in the second school, and they were not guaranteed appointments similar to those promised to their predecessors.

Cambridge University again supplied a principal for the school of naval construction in the person of Dr. Woolley, who proved a worthy successor to Dr. Inman. During the five years of its existence men were trained who subsequently achieved high distinction in the theory and practice of shipbuilding, and who proved capable of taking up the primary responsibility for warship design when age and failing powers compelled the retirement of men trained in the first school. The grave responsibilities incidental to the iron-clad reconstruction were borne, and successfully borne, by men from this college for a period of more than twenty years, and it was a fortunate circumstance that the Central School of Mathematics and Naval Construction was in existence even for so brief a period, because its students ably filled the gap that would have otherwise existed in the ranks of trained naval architects at a most critical period in our naval history.

The third school of naval architecture was founded in 1864, and placed at South Kensington, the Education Department being associated with the Admiralty in its establishment and maintenance. Its creation was due to the action of the Institution of Naval Architects, which had been formed in 1860 on the joint initiative of naval architects trained for the Admiralty service, of a number of leading private shipbuilders and marine engineers, and of naval officers, yachtsmen, and men of science. In many respects the Royal School of Naval Architecture and Marine Engineers differed from, and was more comprehensive than, its predecessors.

The new school was intended to train students for the private industry as well as for Admiralty service. Its founders hoped to attract the sons and relatives of shipbuilders and marine engineers, as well as to provide for young men selected by the Admiralty from the dockyard schools. Marine engineering was recognised as the younger sister of shipbuilding, needing equally good and systematic training for those making it their career. Foreign students were admitted as well as British subjects. The institution was designed to be, or to become, a school of which the greatest maritime nation of the world might be proud. It started under the fairest auspices; there was no failure in organisation, courses of study, teachers, or lecturers; the Admiralty played its part and sent up well-prepared students; foreign Governments also sent students, but in regard to private British students there was disappointment, both as to numbers and previous preparation. What should have been the chief source of supply for British students, and for income, failed lamentably. Looking back on the result, it does not appear so surprising as it did at the time. The scheme of instruction was admir-

able, only it required for its good working a standard of previous attainment, which was reached only by Admiralty students who had spent five or six years in practical work at the dockyards, and in attendance at the special schools therein provided. Even the best of the private students were far less advanced on entry, consequently very few of them were able to benefit fully from the higher and specialised instruction provided at South Kensington. Many private students did derive advantage from attendance, and have shown this to be true in their subsequent careers. On the whole, however, it must be admitted that the scheme was pitched too high in relation to the means of preliminary instruction then existing in this country, and that to give it full effect a preparatory school should have been created also, through which students could have passed before proceeding to the Royal School of Naval Architecture. Even to this day one of the greatest difficulties in the way of utilisation by students of the higher instruction provided in technical colleges consists in the want of proper preparation.

There are certain distinctive features in the arrangements at the Royal Naval College which have stood the test of thirty-five years' experience, and consequently may be worth consideration by those engaged or interested in technical instruction elsewhere. To a few of these I would refer, because they have a bearing on higher technical education in its general aspect.

First, great care is taken thoroughly to prepare the Admiralty students before they enter the college, so that they may derive full advantage from the special facilities existing there. For many years past the Admiralty has maintained at Devonport a college in which those who are to become engineer officers of the Navy receive a practical and scientific training extending over four or five years. Entry to this school has been governed by competitive examinations, and the parents of students have been required to contribute to the expenses of the education of their sons, so that the selection of the students has been made from a higher class than that which furnishes ordinary dockyard apprentices. At the end of the training in this preparatory college a final selection is made of a limited number of students of naval architecture and marine engineering, who proceed to the Royal Naval College to undergo a further period of three years' training in the higher branches of their profession. During the three years' course at the college the summer vacations of the students are spent in the Royal dockyards on practical work, so that Admiralty practice for about forty-four years has represented what is now termed the "sandwich system" of instruction, and it has worked well.

Secondly, private students admitted to the Naval College have been required to possess and give evidence of possessing a knowledge of practical shipbuilding obtained by a period of service in shipyards, as well as a certain standard of attainment in mathematical and scientific subjects. In Germany a similar condition has been insisted on in recent years, and a period of practical training must be undergone by every student who aims at any branch of engineering as his life's work, in the interval between leaving the secondary schools and entering the higher technical schools.

Thirdly, the teachers of naval architecture and marine engineering at the Royal Naval College are officially called "instructors," but really perform the duties of professors. They are appointed only for limited periods, coming from and returning to their professional work. All of them have been distinguished graduates of the college, and, after the completion of their studies, have acquired considerable practical experience at the Admiralty, in the dockyards, and (in many cases) during periods of service at sea. Thus equipped they enter upon their work as teachers. It is ensured that teachers never "lose touch" with the practical side of their professional work, and shall never continue so long in the position of instructors as to become stale, and therefore less capable of dealing with the professorial duties entrusted to them.

Care seems to be required also in another direction at the present time. No teacher of any branch of engineering can be regarded as properly qualified until he has gained actual experience and borne the burden of responsibility in connection with the design and execution of important works. It should never happen that those who teach should be lacking themselves in one side of the training—and that the not less important side—which, by common consent, is needed for the modern engineer. The Admiralty system meets this requirement, and has worked well. It has furnished capable professors of naval architecture and marine engineering, not merely for Admiralty establishments, but for universities at home and abroad.

Turning to results obtained from the work of the Royal Naval College during the last thirty-five years, it must suffice to say that they have been altogether satisfactory when judged by the positions which have been or are occupied by men who graduated there. The Admiralty staff of naval constructors and marine engineers has been mostly recruited from that source, and the highest offices have been successfully filled by ex-students of the Royal Naval College.

It may be interesting to add that about twenty-five years ago the Admiralty constituted a Royal Corps of Naval Constructors. The scheme for that corps provided for the admission of qualified men who had not received their training under the Admiralty, or in Admiralty establishments, subject to the condition that candidates for entry showed proof (by examination and by recorded service) of thorough training in both the science and practice of shipbuilding.

Closely allied with the scientific education of shipbuilders and marine engineers is the provision for instruction of naval officers and shipowners in the fundamental principles governing the construction and propulsion of ships. As regards officers in war-fleets and in mercantile marines, it is advantageous that they should possess some knowledge of the principles of buoyancy, stability, and structural strength, and should have mastered the elements of engineering. On the side of shipowners similar knowledge would undoubtedly assist commercial success. From the nature of the case shipowners must determine the governing conditions of the trades in which ships are to be employed, and naval architects must discover the best possible solutions of the problems laid before them. In the case of warships, naval officers properly claim the right to select the qualities of armament, protection, speed, coal endurance, &c., which they wish to have embodied in designs. It is equally undesirable for the naval architect to assume the right of laying down the conditions to be fulfilled in new designs, as it is for shipowners or naval officers to assume the position of amateur ship designers. If naval officers or shipowners can be endowed with an understanding of the elementary principles affecting ship construction and propulsion they must be better able to appreciate what is or is not possible under the conditions of practice, and therefore they will be much less likely to lay down conditions which are incompatible with one another or impossible of realisation. These considerations led me to suggest in 1873 that the Department of Naval Architecture in the Royal Naval College at Greenwich should include classes in which officers of the higher ranks in the Royal Navy should receive elementary instruction of this kind. These classes have now been in successful operation for more than thirty years, and there is ample evidence of their utility. Subsequently to the establishment of these classes at Greenwich it was decided also to give systematic instruction to junior naval officers in the principles of shipbuilding and engineering, and good results were obtained. In the most recent arrangements for the education of naval officers at Osborne and Dartmouth fuller expression has been given to the same idea, and no one questions the advantages which will be gained thereby. In these days it is obviously a necessity that every naval officer charged with the great responsibilities attaching to the use and management of warships, which are full of complicated machinery, should possess a considerable knowledge of engineering. The only matter on which difference of opinion exists is in regard to the further training of that class of officers who will eventually be placed in responsible charge of the propelling and other machinery of warships.

From the preceding remarks it will be understood that the sole provision made for the higher education of British naval architects for a very long period was in schools established by the Admiralty; but this reproach was re-

moved about a quarter of a century ago by the creation of a professorship of naval architecture in the University of Glasgow, thanks to the generosity of Mrs. John Elder. About the same time a professorship of engineering was established in connection with the University of Durham at the College of Science (now the Armstrong College), Newcastle-on-Tyne, and instruction in naval architecture is included in the curriculum of studies in this department. It was always desired to have an independent professorship of naval architecture in this great centre of shipbuilding, and by persistent effort this desire was fulfilled about a year ago. The country now possesses three schools of naval architecture, two of which are independent of the Admiralty, and sustained by the private shipbuilding industry.

It has been suggested that the multiplication of schools of naval architecture in Great Britain may be overdone, but when compared with the provision now made for the education of naval architects in Germany, France, and the United States, and taking into account the overwhelming preponderance of British shipowning and shipbuilding, there need be no fear that four schools of naval architecture, each with a considerable number of students, would constitute an excessive provision for this country. In the Technical High School of Charlottenburg, near Berlin, there were not long ago about 400 students of naval architecture and marine engineering, all of whom had received adequate preparatory training before entering the high school and specialising in these studies. Even at the present time the total number of equally qualified students of naval architecture and marine engineering attending the classes in British schools is only about 170, or less than one-half the number of men studying at Charlottenburg. In the United States excellent schools of naval architecture exist at the Massachusetts Institute of Technology and as departments in several universities. These are well equipped, and attended by considerable numbers of students. When it is borne in mind that the aggregate tonnage of steamships belonging to the British Empire is seventeen millions of tons, as against 3,705,000 tons owned by Germany and 1,542,000 (exclusive of the shipping on the great lakes) owned by the United States, and that in 1907 the gross tonnage of ships launched in the United Kingdom aggregated 1,608,000 tons, as against 291,000 tons for Germany and 486,300 tons for the United States, it will hardly be maintained that the provision made or contemplated for the higher education of British naval architects is likely to prove excessive.

Possibly it may be thought that the German provision for such education is extravagantly large, and that the number of highly trained men who annually pass out from the High School at Charlottenburg is in excess of the real requirements of the shipbuilding industry of that country. This is not the opinion entertained in Germany itself, for another school of naval architecture has been created at Dantzic recently.

The last half-century has witnessed unprecedented progress in British shipping and shipbuilding. It is apt to be forgotten that when the Civil War broke out the tonnage of American shipping was rapidly overtaking that of this country, and threatened to surpass it before long. It is true, no doubt, that the lead which we took in the use of iron instead of wood as the chief material of construction, and in the development of steam navigation, helped forward the remarkable progress that has been made. It is equally true that great assistance to progress has been given by the application of scientific methods to ship construction and propulsion. It would be ridiculous to suppose that the contemporaneous development of technical and scientific training amongst naval architects and marine engineers had only been a coincidence, and had not played a great part. Many circumstances, as well as many persons, have assisted in bringing British shipping and shipbuilding into its present unrivalled condition, but the underlying and predominant cause must be found in the general recognition of the necessity for scientific as well as practical training on the part of those engaged in the design and construction of ships and their machinery.

Ship-designing can never be dealt with on purely scientific methods. Exact estimates cannot be made of the most trying conditions to which ships at sea may be subjected. Accumulated experience, based on careful observation and experiment, must always be the foundation of successful work. Direct experiments on models of ships and propellers are of incalculable value; but the arrangement and conduct of these experiments, the carrying out of observations on the behaviour of ships, the grouping and analysis of results, and the deduction therefrom of facts and principles for future guidance, all demand scientific knowledge and scientific procedure. Of course, this is not peculiar to shipbuilding, and I have no desire to magnify the importance of that branch of engineering to which my life has been devoted. It is equally true of engineering as a whole, and of the applications of science to industrial processes generally. My chief object in describing to-night what has been done in the technical education of naval architects has been to present an object-lesson to those interested in technical education as a whole.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Prof. Adam Sedgwick, president of the Philosophical Society, has been appointed to represent the society at the Darwin centenary celebrations in June, 1909.

In a letter to the Vice-Chancellor, the secretaries of the Royal Society announce that, as Sir William Huggins desires now to relinquish the care of the stellar spectroscopic equipment placed in his hands by the Royal Society in 1871, the president and council of the society are prepared to present these instruments as a gift towards the equipment of the astrophysical department of the Cambridge Observatory, subject to an assurance of their permanent profitable employment being obtained. This assurance having been given by the observatory syndicate, the installation will be transferred permanently to the University as it now stands in full working order in Sir William Huggins's observatory. In view of the historical importance of this equipment, and its intimate connection with the foundation and development of the science of astrophysics, it is desired that the name of Sir William Huggins be permanently connected with the instruments.

The electors to the Isaac Newton studentships give notice that, in accordance with the regulations, an election to a studentship will be held in the Lent term, 1909. These studentships are for the encouragement of study and research in astronomy and physical optics. The persons eligible are members of the University who have been admitted to the degree of Bachelor of Arts, and who will be under the age of twenty-five years on the first day of January, 1909. It will be the duty of the student to devote himself during the tenure of his studentship to study or research in some branch of astronomy or physical optics. The student's course of study or research must be, as a rule, pursued at Cambridge. The studentship will be tenable for the term of three years from April 15, 1909. The emolument of the student will be 200*l.* per annum, provided that the income of the fund is capable of bearing such charge.

LONDON.—The new deans of faculties are:—for medicine, Prof. S. H. C. Martin, F.R.S.; for science, Prof. J. M. Thomson, F.R.S.; for engineering, Prof. W. E. Dalby.

Prof. T. G. Brodie has resigned his post as professor-superintendent of the Brown Animal Sanatory Institution on his appointment as professor of physiology in the University of Toronto.

The degree of D.Sc. in physiology has been granted to Dr. F. H. Scott, an internal student, of University College, who submitted a thesis entitled "On the Relative Parts played by Nervous and Chemical Factors in the Regulation of Respiration," and other papers; also to Dr. H. W. Bywaters, an internal student, of the physiological laboratory of the University, who submitted a thesis entitled "An Inquiry into the Chemical Mechanism concerning the Absorption of Protein and Carbohydrate Food," and other papers.

A separate board of studies is to be constituted for ethnology.

THE council of the University College, Bristol, has appointed Dr. John Beddoe, F.R.S., honorary professor of anthropology.

DR. V. H. BLACKMAN, professor of botany in the University of Leeds, has been appointed by the Senate to represent the University at the commemoration, in June next, at the University of Cambridge, of the centenary of Darwin's birth and the fiftieth anniversary of the publication of the "Origin of Species."

LORD IVEAGH has been elected Chancellor of the University of Dublin in succession to the late Lord Rosse. Lord Iveagh has been a generous benefactor of the University, and contributed a sum of 16,500*l.* for the construction and equipment of the laboratory of experimental physics, which was completed in 1906.

SPEAKING at Edinburgh on November 19, in opening the new science and art rooms of George Watson's College for Boys, Lord Avebury said that, considering how much we owe to science, it is a marvel that so little time is devoted to the study of nature in the public-school and university system. Scientific men do not undervalue or wish to exclude classics from the curriculum, but their point of view is that a man, however much he may know of the dead languages, if he knows nothing of science is but a half-educated man after all.

AN article by Prof. Rudolf Tombo, jun., in *Science* for October 30 last, on the geographical distribution of the student body at a number of American universities and colleges, deals incidentally with the number of foreign students in attendance at these institutions. The total number of students from foreign countries in attendance at the twenty-seven institutions in the United States selected for the purposes of the comparison is 1088. Of this number Europe contributes 219, Asia 332, Australasia 58, and Africa 9. Pennsylvania University has the largest foreign clientele, followed by Columbia, Cornell, and Harvard, each of which attracts more than one hundred foreigners. Taking the representation of foreigners at all the selected institutions, we find that the largest number of students are sent by the following countries:—Canada, 210; Japan, 142; China, 139; Mexico, 90; Cuba, 67; Great Britain and Ireland, 60; Argentine Republic, 56; and India, 54. Of European countries, England sends the largest number, namely, 60, followed by Russia with 40 and Germany with 32. Of the students from Great Britain and Ireland, 8 attend Columbia University, 9 Harvard, and 12 Pennsylvania.

THE opening of the new memorial buildings at Eton College by the King took place on Wednesday, November 18. The ceremony was most impressive, and the King's reply to the address of the boys expressed in admirably clear and dignified words the feelings which must have pervaded the whole assembly. "You all have the opportunity of leaving Eton trained in the knowledge and accomplishments of English gentlemen, and disciplined to the self-restraint, the consideration for others, and the loyal acceptance of private and public duties which are the ideals of our race. I exhort you to value and make the most of that training and discipline. You can have no better example than that of the brave men of whom this splendid building is a loyal and lasting memorial." It would be difficult to give a better expression to the public-school ideal, and the King's words may well be studied by every school in his kingdom. Eton has for some time possessed laboratories, chemical, physical, and biological, as well as workshops, and, as at other public schools, boys have the opportunity of acquiring some of the wider culture which science is ready to supply, and which Osborne and Dartmouth are adding to the knowledge and accomplishments of English princes; but hitherto Eton has had no single building capable of accommodating the whole school. The new hall supplies this defect, and it will be used for concerts and lectures, provision having been made for an electric lantern. The acoustic properties of the hall seem to be excellent, and every word, not only of the King's speeches, but also of the address read by the captain of the school, was distinctly audible. Adjoining the hall is a dome, in which the school library will find adequate accommodation.

THE annual report of the Glasgow and West of Scotland Technical College, adopted by the governors of the college at the end of September last, has reached us. There was during the session 1907–8 an increase of 156 students, bringing the total up to 5918 individuals if, as is done in the report, the pupils of Allan Glen's School are included. We observe that the completion of the long-contemplated amalgamation of the Incorporated Weaving, Dyeing, and Printing College with the Technical College has been effected, and this department, like all the other departments of the college, will continue under the supervision of leading members of the industry with which the work is associated. A condition of the amalgamation is that the governors shall make their best endeavours to provide new premises for the weaving department in the new buildings. Efforts are to be made to improve the preliminary education of students entering the college; notice has been given that in September, 1910, the standard of the preliminary examination will be raised to that of the leaving certificate of the Scotch Education Department. As the report points out, there is no reason why a boy of average capacity and diligence should not obtain this certificate at the age of seventeen or eighteen. The report acknowledges the encouragement received by the college from the Carnegie Trust for the Universities of Scotland by a grant of 4000*l.*, from the Education Department by an additional grant of 8805*l.* towards the building and equipment fund, from the Corporation of Glasgow of a sum of 4500*l.* from the residue grant, and also 900*l.* in respect of the weaving college, and from local associations, industrial firms, and others by gifts of prizes for students and of material for use in the laboratories.

THE report on the work of the department of technology of the City and Guilds of London Institute for the session 1907–8 has reached us. We notice that since the institute, some sixteen years ago, first established classes for the training of teachers in the use of wood-working and metal-working tools, instruction in this subject has made great advances, and has been very much improved. Originally introduced by way of experiment in a few elementary schools, manual training is now a recognised subject in the curriculum of most elementary and secondary schools, and is one of the subjects studied by men students in training colleges for teachers in elementary schools. A recent alteration in the Board of Education Code regulating the work of public elementary schools, by which boys of eleven years of age are admitted to classes in handicrafts, will result most probably in a further demand for qualified teachers in these subjects. The technology committee of the institute directs attention to the fact that the Board of Education has under consideration the question of developing all forms of manual instruction and of encouraging continuity throughout such teaching from the classes for infants to the upper standards of the elementary school. Since 1892, the date of the first public examination, 4861 teachers' certificates in manual training have been awarded by the institute. The work of the department as a whole continues to progress. The number of subjects in which examinations were held during the year dealt with in the report was seventy-two, as compared with sixty-nine in the previous year, the number of separate classes increased from 3311 to 3604, and the number of students in attendance from 46,048 to 48,223. The programme of courses of instruction for the current year contains, the report states, seventy-six different syllabuses, including courses of instruction relating to more than a hundred distinct branches of industry.

PART ii. of vol. i. of the Journal of the Municipal School of Technology, Manchester—a record of the work of the school—has just been issued. It consists of 130 pages of reprints of ten papers written by members of the staff of the school, and communicated to the scientific societies or published in the scientific Press during the four years 1903–7. One of the papers deals with a mathematical, another with an electrical, a third with a sanitary, two with engineering, and five with chemical questions. The journal is printed in the school, and reflects great credit on the printing department. Its issue raises several momentous questions. In the first place, Manchester appears to be the only technical school in this country

which considers it worth its while to reprint the papers written by the members of its staff, and the conclusion is forced on us that no one of the dozen polytechnics of London or of the score of technical schools in the large towns of the provinces—Birmingham, Glasgow, Belfast, and others—contributes to the advancement of science so much as Manchester does. In the next place, it may reasonably be asked, Is Manchester doing as much as it ought to do in this direction? To answer this question we must remember that the school cost a third of a million, has a staff of nearly 100, and claims to be second to none in the kingdom in point of equipment. Judging by Continental schools, about one-sixth of the staff might reasonably be expected to be doing something to solve the problems met with in their own departments, and on this basis Manchester does not yet produce its proper quota of research; and if Manchester does not, what must be the state of the other schools of the kingdom? and why are they in this state? They were founded for the training of those who intend to apply science to industry, who can render no greater service to industry than the solution of some of its problems. What better training for this purpose can there be than working out one of those problems under the guidance of a teacher, and how can the teachers act as guides unless they themselves have been pioneers? No technical school is fulfilling its highest purpose when its staff is not carrying out research, but is merely retailing text-book knowledge which, from the nature of things, must be a dozen years behind the times. Yet how many of the schools of the kingdom are content to do nothing better than point to their records of how many thousand students have passed through them, and probably learnt nothing more up-to-date than Euclid or the atomic theory, both of which they might have learnt just as well in any primary school?

THE seventh annual meeting of the North of England Education Conference is to be held on January 7, 8, and 9, 1909. United conferences are to be held in the Manchester Town Hall on the mornings of January 8 and 9, and sectional meetings at the Manchester Municipal School of Technology in the afternoons of the same days. One of the subjects for discussion in the sectional meetings of the second day of the conference is the training of girls in domestic subjects, concerning which papers are to be read by Miss Alice Ravenhill and Miss E. J. Ross. The united conference on the concluding day is for the discussion of the coordination of the curricula in primary and secondary schools, and papers are to be read by Messrs. J. L. Paton and J. W. Iliffe and Miss Isabel Cleghorn. The following subjects are to be considered in sectional meetings on the last day of the conference:—the place of the higher elementary school in the scheme of education, with papers read by Mr. C. H. Wyatt and Prof. J. J. Findlay; the relation of the universities to evening teaching in industrial centres; papers by Messrs. R. H. Tawney and W. J. Bees; and methods of teaching mathematics; papers by Messrs. T. J. Garstang and H. Brotherton. The committee has deemed it desirable to ask delegates to pay a membership subscription of one shilling, which will contribute in some measure towards the expense involved. Admission to the conference meetings will be by ticket, application for which should be made to the honorary secretaries at the Manchester Municipal School of Technology, accompanied by a postal order or stamps for one shilling as membership subscription in respect of each person attending the conference. The committee has arranged to display the Manchester Education Committee's exhibit as shown at the recent Franco-British Exhibition. It is designed to show the complete and varied educational work of a large county borough, and will be set up in the examination hall of the Municipal School of Technology. A comprehensive exhibition of educational apparatus and books will also be arranged.

FOR more than a year a committee, composed of representatives of the University of Oxford, on the one hand, and of labour representatives on the other, has been considering the question of the relation between the University of Oxford and the education of working men. It is expected that the report of the deliberations of the committee will be published shortly. In connection with the same movement a conference, largely attended by delegates of trades unions and other organisations of working men, was held on November 21 at Toynbee Hall. The scheme to be recommended by the Oxford committee in the forthcoming report was described by the joint secretary. The Bishop of Birmingham delivered an address, during the course of which he said it appears to him to be beyond the possibility of question that the proportion of young men who are at Oxford because it is "the right thing" to go to Oxford and because they want to have a good time is ridiculously great. No serious person can think about Oxford without seeing that this is a gross misappropriation of the purposes and resources of the University, and that, by one means or another, it requires fundamental alteration. A system is to be desired in which it shall be understood clearly, and effectively brought about, that persons who do not at once show that they come to the University because they want to be students will have to go elsewhere. If carried out there would be a great displacement of well-to-do young men who want to have a good time by serious students who would come equally from all classes, but in large measure from among the workers. There is in most classes a body of people who want to be serious students, and possess the requisite qualifications. These persons have the right to be at the University, because it exists for such students. The endowments of the place should be so re-arranged as really to be again applicable to the ends for which they were first given, namely, to enable those who have no means of their own, but have the capacity and desire to be students, to avail themselves of the resources and the opportunities of the great centres of learning. Then would follow a re-modelling in the University of the whole scale and standard of living.

SOCIETIES AND ACADEMIES.

LONDON.

Challenger Society, October 28.—Mr. A. E. Shipley, F.R.S., in the chair.—Ostracoda of the Bay of Biscay captured during the 1900 cruise of H.M.S. *Research*: Dr. G. H. **Fowler**. More than 7000 specimens had been identified, and in the case of more than 3000 the sex had been determined and the length of the shell measured. As the result of these measurements the author was enabled to formulate provisionally a new law of growth in Crustacea:—"during early growth each stage increases at each moult by a fixed percentage of its length which is constant for the species and sex"; for this the name of Brooks's law was suggested, Prof. W. K. Brooks having made the first observations which led to it; it had been checked to some extent by observations on lobsters (Herrick) and crabs (Waddington). In several cases it was shown that two stages of the same species had been described as different species. Twenty-five species occurred in the collection, and in some cases as many as five stages had been recognised. As regards the vertical distribution, attention was directed to an increase in the number of specimens captured between 750–400 fathoms as compared with those from 400–100 fathoms, and the suggestion made that this was due to a check in the velocity of fall of dead and dying specimens, produced by the increased viscosity of the water, which in its turn was dependent on increased pressure and diminished temperature. All the four plentiful species, which were recognised on other grounds as mesoplanktonic, attained their maximum intensity in this zone, which would constitute a rich food-zone. Three species were apparently purely mesoplanktonic; eleven reached their maximum intensity in or near the epiplankton, but extended into the mesoplankton, and of these eleven three were apparently purely mesoplanktonic at their oldest stage; four were purely mesoplanktonic. The question of the vertical oscillation of the species was discussed, and several were shown to be more abundant in the epiplankton by night than by day; in one case an attempt was made to trace the movement of the species at different times of day. The proportion of males to females seemed to point to the probability that one species was parthenogenetic.

In another species the death-rate at three stages was worked out, and appeared to be 50 per cent. Except in one case the maximum intensity of closely similar species appeared to be at different levels.

Geological Society, November 4.—Prof. W. J. Sollas, F.R.S., president, in the chair.—The relations of the Nubian Sandstone and the crystalline rocks of Egypt: Hugh J. L. **Beadnell.** The conclusions of previous observers are mainly in favour of the view that the granites are not intrusive into the Nubian Sandstone, but that the latter was deposited round denuded masses of the granite. The crystalline rocks south of the Oasis of Kharga are first dealt with. Eight exposures of crystalline rocks were met. The sediments near the contact with the crystalline rocks are generally inclined at a high angle. The bedded rocks contain no fragments derived from the crystalline rocks. The author concludes that the Nubian Sandstone was unconformably deposited, partly on preexisting sedimentary formations, and partly on the planed-down surfaces of still older crystalline and metamorphic rocks. Subsequently it was invaded by outbursts from the underlying magma, the intrusions being probably connected with the elevation of the mountainous regions on the east side of the Nile.—The fossil plants of the Waldershare and Fredville series of the Kent coalfield: E. A. Newell **Arber.** At the boring at Shakespeare Cliff, Dover, Coal-measures were reached at a depth of 1100 feet, and subsequently penetrated to a depth of about 2270 feet. Thirteen seams of coal, varying in thickness from 1 foot to 4 feet, were pierced. Coal-measures were struck at 1394 feet at the boring in Waldershare Park, and pierced for 1260 feet more. Five seams of coal, varying from 1 foot 4 inches to 5 feet 2 inches in thickness, were struck. The boring near Fredville Park reached Coal-measures at 1363 feet, pierced three seams of coal, and was continued to a depth of 1813 feet. The specimens of plants collected from the Waldershare and Fredville borings were compared with plants found at Dover and in other localities in Britain and abroad. The majority of species tabulated are either confined to the Upper Coal-measures and the transition series below, or are Middle and Lower Coal-measure forms which are known to occur in the transition series. Thus the beds are the homotaxial equivalents of the Newcastle, Etruria, and black-band horizons of north Staffordshire, the Hamstead beds below 1233 feet in south Staffordshire, the Coed-yr-allt beds and Ruabon marls of Denbighshire, the Ardwick series and beds above the Bradford four-foot coal in south Lancashire, the Lower Pennant Grit of South Wales, and the New Rock and Vobster series of Somerset. The majority of species are also common to the highest zone, or the "Charbons Gras," in the Pas de Calais.

Entomological Society, November 4.—Mr. C. O. Waterhouse, president, in the chair.—*Exhibits.*—W. G. **Sheldon**: Examples of *Melitaea aurinia*, var. *iberica*, from Barcelona, taken last May, and examples from various British and Continental localities for comparison, suggesting that eventually this particular form of *aurinia* might prove to be a distinct species.—Rare Tachinidæ: H. W. **Andrews.** A short series of *Gymnosoma rotundatum*, L., and a specimen of *Ocyptera brassicaria*, F.—two uncommon Tachinids—from Glengarriff, co. Cork.—Erebias from the Vosges: P. J. **Barraud.** A series of *Erebia stygne* and *E. ligea* from the French Vosges, taken in June and July this year.—Nonagria new to Britain: E. P. **Sharpe** and A. J. **Wightman.** A series of *Nonagria edelsteni*, wrongly identified as *N. neurica*, Hb., from Sussex, taken in August this year, this being the first time that the species, which is quite distinct, had been observed.—Pseudogynes of *Formica rufa*: H. St. J. **Donisthorpe.** Pseudogynes captured alive at Nethy Bridge in September last, where they occurred in some numbers in two nests of *Formica rufa*, thus indicating that *Atemeles pubicollis*, Bris., a beetle new to Britain, is to be found in Scotland.—Rare British Coleoptera: H. St. J. **Donisthorpe.** Examples of *Harpalus cupreus*, Dej., from Sandown, Isle of Wight (one specimen with red legs discovered by Mr. J. Taylor at Atherstone); *Cafius cicatricosus*, Er., from Southsea; and *Cryptocephalus bipunctatus*, L., taken at Niton, Isle of Wight, where it was discovered by Mr. R. S. Mitford last year.—A "stick" insect—apparently a new species of the genus Melaxinus—bred parthenogenetically by Mr. H. Main: R. **Shelford.**—A long series of hybrid *S. ocellatus* $\times$ *populi*: L. W. **Newman.**—Life-histories of Coleophorids and hybernating Porthesia: H. J. **Turner.** (1) Ova, larvæ, and photomicrographs to illustrate the life-history of *Coleophora virgaureae.* (2) "Nests" of the gregarious hybernating larvæ of *Porthesia chrysorrhoea* from Wakering marshes, Essex; on several parts of the coast this species has now become very abundant again. (3) Dead flower-stems of *Statice limonium* collected on November 1, containing the full-fed hybernating larvæ of *Coleophora limoniella.*—Rare earwig and cells of wasp: W. J. **Lucas.** (1) An example of *Labidura riparia*, Pall. (shore earwig), a large male taken near Bournemouth, August 10, and kept alive since that date. (2) Two cells of the solitary wasp *Eumenes coarctata* found in the New Forest.—Specimens of the genera Celastrina (Cyaniris) and Everes to demonstrate the racial identity of *C. sikkima* and *C. argiolus*, *C. jynteana* and *C. limbatus*, *E. diparodes* and *E. argiades*: Dr. T. A. **Chapman.** All these species occur together, and appear to form a mimetic group, but it would be impossible at present to determine which is the model and what may be the object of the mimicry.—The male and female imago, the preserved larva, and the cocoon of an interesting new Lasiocampid from Durban: Prof. E. B. **Poulton.**—Butterflies captured on a patch of zinnias on the north of the Victoria Nyanza: Prof. E. B. **Poulton.** Seventeen specimens were shown of *Danais chrysippus*, L., of the type, and *alcippus* forms together with the intermediate examples, but no single specimen of *dorippus* (*klugii*), although of three females of *Hypolimnas misippus*, L., two were of the *inaria*, Cr., form mimicking *dorippus.*—Specimens of *Heliconius amphitrite*, Riff., and *H. charithonia*, Linn., also a coloured drawing of *H. hermathena*, Hew.: Dr. F. A. **Dixey.** Each of the first two species showed a distinct and well-marked aposeme or warning character, each of them, and especially the first, belonging to an extensive mimetic assemblage. In the third species these two distinct aposemes were combined.—Aberrant forms of *Polyommatus bellargus* and of *Zygaena trifolii* and *Z. hippocrepidis*: Dr. G. G. **Hodgson.**—The life-history of *Erianthus versicolor*, Brunner, an Orthopteron of the family Mastacidæ: J. C. **Kershaw.**

Linnean Society, November 5.—Dr. D. H. Scott, F.R.S., president, in the chair.—Notes on some parasitic Copepoda, with a description of a new species of Chondracanthus = *C. inflatus*: Miss M. E. **Bainbridge.**—Some nemerteans from the eastern Indian Ocean: R. C. **Punnett** and C. F. **Cooper.**—Report on the echinoderms, other than holothurians, collected by Mr. Stanley Gardiner in the western parts of the Indian Ocean: Prof. F. Jeffrey **Bell.**

Mathematical Society, November 12.—Prof. W. Burnside, president, and subsequently Prof. H. M. Macdonald, vice-president, in the chair.—Address of the retiring president: Prof. W. **Burnside.** The address dealt with the neglect of the theory of groups of a finite order by English mathematicians. It was pointed out that numerous opportunities arise in comparatively elementary teaching for emphasising the importance of some of the simpler notions of the theory of groups. If such opportunities were taken a student of the more advanced theory would approach it with a mind already stored with concrete examples.—(1) The second mean value theorem of integral calculus; (2) the representation of a function by means of a series of Legendre's functions: Dr. E. W. **Hobson.** In the second of these papers it is pointed out that a difficulty, not presented in the analogous theory of Fourier's series, arises in the theory of the expansion of a function in a series of Legendre's functions, through the existence of two critical points of the differential equation satisfied by these functions, and an asymptotic formula for the functions of high index, valid in the neighbourhood of the critical points, is obtained. The eliminant of three quantics in two independent variables: A. L. **Dixon.** A method is given for exhibiting the eliminant as a single determinant, the elements of which are formed by a rule

analogous to Bezout's rule for forming the eliminant of two quantics in one independent variable.—The Dirichlet series and the asymptotic expansion of integral functions of zero order: J. E. **Littlewood.**—The norm curves on a given base: Prof. F. **Morley.**—The arithmetical nature of the coefficients in a group of linear substitutions (third paper): Prof. W. **Burnside.**—The conformal transformations of a space of four dimensions and their applications to geometrical optics: H. **Bateman.**—Periodic properties of partitions: D. M. Y. **Sommerville.**—The solution of integral equations: Prof. A. C. **Dixon.**—Note on the continuity or discontinuity of a function defined by an infinite product: G. H. **Hardy.**—The energy and momentum of an ellipsoidal electron: F. B. **Pidduck.** (1) q-Integration; (2) q-transformations of power series: Rev. F. H. **Jackson.**—The complete solution in integers of the Eulerian equation $X^4+Y^4=U^4+V^4$: Dr. T. **Stuart.** Waves of finite amplitude: W. J. **Harrison.**—An asymptotic formula for the generalised hypergeometric series: T. J. I'A. **Bromwich.**—Satellite curves of a plane cubic: A. C. **O'Sullivan.**

Royal Meteorological Society, November 18.—Dr. H. R. Mill, president, in the chair.—Investigation of the electrical state of the upper atmosphere, made at the Howard Estate Observatory, Glossop: W. **Makower,** Miss M. **White,** and E. **Marsden.** There exists under normal atmospheric conditions a potential gradient in the atmosphere surrounding the earth. The earth being negatively charged with respect to the air, a continuous electric current flows from the upper atmosphere to the earth. It follows, therefore, that a kite attached to an earth-connected wire will tend to assume the potential of the air surrounding it, and an electric current will flow continuously down the wire to earth through the winding machine to which the wire is attached. The experiments described in the paper were undertaken with the view of determining the magnitude of this current when the kite was at different heights above the ground. The authors found that in general a high wind produced at a given altitude an abnormally high value of the current flowing down the wire. Whether the action of the wind is to be accounted for by the greater volume of air which passes in a given time over the sails of the kite, so giving a greater volume of air from which electricity is collected, or whether the action of the wind is to be attributed to electrification by friction, the authors find it difficult to say, but there is no question that the velocity of the wind does play an important part in determining the current flowing down the kite wire. In further confirmation it may be added that observations made with a captive balloon in very calm weather gave abnormally low values for the current.—Balloon observations made at Birdhill, co. Limerick, during July and August, 1908: Captain C. H. **Ley.** These observations were carried out on behalf of the joint kite committee of the Royal Meteorological Society and of the British Association. Captain Ley in this paper gave full details of the observations made on twenty-five pilot balloons, seven of which carried registering instruments. The method employed is similar to that known by surveyors as the subtense method, that is, obtaining the range of a known vertical bar by observation of the angle subtended by it at the theodolite with an eye-piece micrometer. In this case the bar is the line joining a hydrogen balloon and a comparatively heavy air-filled balloon, and the balloons appear as discs to be bisected simultaneously by the fixed and movable wire in the diaphragm. Several balloons were observed to a horizontal distance of twenty-four miles. Two of the balloons dropped in the river Shannon; these were sent up in exceptionally calm atmosphere, and Captain Ley considers that the river had a suction effect upon them. The immediate neighbourhood of stratus or cirrus cloud appears to cause a collapse of vertical velocity, and, generally speaking, the highest horizontal velocity of wind appears to occur below the cirrus level. A feature developed during the course of the experiments was the observation of the balloons at night by means of naked acetylene lights. After some trouble these proved quite successful, gave long runs with less risk of being lost in small clouds, and afforded points of light which could be observed on with great accuracy.

Institution of Mining and Metallurgy, November 19.—Mr. Alfred James, president, in the chair.—Notes on tin dressing: H. W. **Hutchin.** A record of investigations of dressing operations conducted at South Crofty Mine with the view of determining the losses incurred in tin dressing and their nature. The ground covered embraced mainly the first stage of concentration, in preparing concentrates for the calciner, and comprised a systematic investigation of the battery tailings. The range of the present inquiry was, however, restricted to tin alone of all the metallic constituents, and in this connection the author had collected a mass of valuable data resulting from experiments with different grades of crushing and different modes of treatment.—Working costs on mines, as practised on the Rand: J. A. **Dennison.** In this paper, which was originally submitted to the standardisation sectional committee of the institution dealing with mine accounts and cost sheets, the author reviews the practice of the Rand with the object of seeing to what extent it is capable of standardisation in itself and as a guide to other localities. His brief is in favour of standardising general principles and systems rather than details, and of securing the utmost simplicity consistent with a clear and full statement of accounts.—A manganese deposit in southern India: R. O. **Ahlers.** A description of the manganese deposits in the native State of Sandur, Bellary district, an elliptical basin composed geologically of a bed of the Dharwar (Archæan) series of schistose rocks, which is surrounded by gneiss, the predominating rock in that part of India. Iron and manganese are intimately associated in the Sandur deposits, which, though of large extent on the surface, go but a short distance in depth. The author inclines to the theory that these ore bodies are the result of metasomatic action, a replacement of the original rock by oxides of manganese and iron, by the agency of meteoric waters.—Extinguishing the fire in the Testasecca Mine, Sicily: F. C. **Chrambach.** A brief description of the method adopted in dealing with an incendiary outbreak in a sulphur mine in Sicily, the operation being greatly assisted by the employment of the Westphalia "rescue" apparatus, whereby the working party was enabled to penetrate and carry on its labours in the highly vitiated air of the underground sections.

Manchester.

Literary and Philosophical Society, October 20.—Prof. H. B. Dixon, F.R.S., president, in the chair.—Further notes on the separation of cobalt and nickel: R. L. **Taylor.** The author referred to a former paper in which he described a modification of Rose's method (barium or calcium carbonate in presence of chlorine or bromine). In that paper he pointed out that various conditions caused a remarkable retardation in the precipitation of the cobalt. He now proposes the use of magnesium carbonate instead of calcium or barium carbonate, and finds that with this there is practically no uncertainty in the action.—Some questions connected with the constitution of the atom: H. **Bateman.** It is shown that a continuous succession of infinitesimal conformal transformations of space can be derived by stereographic projection from a figure on a hypersphere which moves as a rigid body in a space of four dimensions. This gives ten degrees of freedom, so that the model atom would have at most ten degrees of freedom. It is suggested that the number of degrees of freedom possessed by an atom in given circumstances is equal to three *plus* the valency exhibited in those circumstances. When two atoms are in a state of chemical combination there is, in general, a loss of three degrees of freedom for a single bond and five degrees of freedom for a double bond. By means of this rule it is possible to calculate the number of degrees of freedom of a molecule. In the case of a molecule consisting of several atoms there are additional restrictions due to the atoms arranging themselves at equal distances from one another or in a plane. The ratio of the specific heats calculated from the numbers n obtained in this way and the formula $\gamma=1+2/n$ agree with the results of observation.—A collection of fossil insects from Shiobara, Japan, collected by Dr. Marie Stopes: C. Gordon **Hewitt.** In the collection there were a large number of the aquatic larvæ of ephemerids. There were

examples of certain larvæ and a single pupa of insects belonging to the dipterous family Culicidæ. In addition to these, a number of different families of Diptera were represented, including one or two excellently preserved specimens of Culicidæ. The insects are preserved in a light grey laminated shale, and the fossiliferous deposit is evidently of fresh-water origin, and appears to belong to the Tertiary age.

November 3.—Prof. H. B. Dixon, F.R.S., president, in the chair.—The nature of the α particle: Prof. E. **Rutherford** and T. **Royds**. In order to give a definite proof of the identity of the α particle with a helium atom, it is necessary to show that helium can be obtained from accumulated α particles, quite independently of the active matter from which they are expelled. This has been done by the authors. In the experiments every precaution was taken to prevent possible contamination of the apparatus with helium. The experiments afford a conclusive proof that the α particle after losing its charge is an atom of helium. Other evidence indicates that the positive charge on the α particle is twice that carried by the hydrogen atom.—The action of the radium emanation on water: T. **Royds** and Prof. E. **Rutherford**.—Some properties of the radium emanation: Prof. E. **Rutherford**. In 1906 (NATURE, October 25) the author directed attention to the fact that the emanations of radium, thorium, and actinium were completely absorbed by cocoa-nut charcoal at ordinary temperatures. He has recently repeated these experiments with much larger quantities of radium emanation, and has found that the actual volume of emanation capable of absorption by charcoal at room temperature is very small. For example, several grams of cocoa-nut charcoal are required to absorb completely the emanation from 200 milligrams of radium at ordinary temperature, although the volume of the gas is only one-tenth of a cubic millimetre. As was to be expected, the absorptive power of charcoal for the emanation increases rapidly with lowering of the temperature. It appears from the results that at 10° C. the charcoal absorbs about 0·03 cubic mm. of emanation per gram, and at −40° C. about 0·06 cubic mm. per gram.

PARIS.

Academy of Sciences, November 16.—M. Bouchard in the chair.—Compensation of a closed chain of triangulation: P. **Hatt**. In a closed chain of triangles resulting from a survey, there is necessarily a slight discrepancy at the junction owing to the experimental error. The problem of the distribution of this error round the whole system, giving a polygon with a minimum deformation, in the general case is extremely complicated, and involves an amount of labour out of all proportion to the value of the result. A shortened approximate method of dealing with this problem is given in the present paper.—The turning of aëroplanes: E. L. **Bertin**.—The use of calcium cyanamide in agriculture: A. **Müntz** and P. **Nottin**. It has been shown in previous papers that the rapidity with which nitrogenous manures are converted into nitrates is a measure of their usefulness as manures, and calcium cyanamide has been studied from this point of view. It proved to be as active as ammonium sulphate, and this result was confirmed by culture experiments.—A new species of Sarcocaulon of south Madagascar and the resinous bark of Sarcocaulon: Édouard **Heckel**. The resin is present in the bark to the extent of 20 per cent. to 30 per cent., and owing to its perfume may prove to be of commercial value.—Report on a memoir entitled "Experimental Researches on the Resistance of the Air carried out by M. G. Eiffel": Maurice **Levy** and M. **Sebert**. An account of experiments on the resistance of the air to falling bodies, carried out on the Eiffel Tower.—Yellow fever at Saint-Nazaire: M. **Chantemesse**. The infection was brought from Martinique by the steamship *La France* on September 24, and as no case had developed during the nine days' voyage from the infected port, the vessel was not placed in quarantine by the port authorities. Eleven cases resulted, seven of which were fatal. The infection was carried by the mosquito *Stegomya fasciata*, specimens of which were caught on the ship after the epidemic broke out.—Differential equations of the third order the general integral of which is uniform: R. **Garnier**. The resistance of fluids: the necessary experiments: Marcel **Brillouin**. The rational construction of aëroplanes requires the experimental determination of numerous coefficients, the more important of which are indicated.—Different curves of the same sung vowel: M. **Marage**.—The radio-activity of the soil: F. **Bordas**. The radiations from radio-active materials are known to possess the property of causing colorations in glass and porcelain, and the fact that in certain regions near the nitrate mines of the province of Aconcagua white glass became coloured has led to the discovery that at certain spots the soil is strongly radio-active.—The volumetric composition of ammonia gas and the atomic weight of nitrogen: Ph. A. **Guye** and A. **Pintza**. Ammonia, set free from a weighed apparatus, was decomposed by passing over an electrically heated platinum spiral, and the mixed gases measured at a definite temperature and pressure. The method, which is not capable of high precision, gave 14·014 as the atomic weight of nitrogen (O = 16), the extreme values being 14·002 and 14·022, a new confirmation of the international value 14·01.—Some constituent principles of *Sclerostomum equinum*. The presence in this parasite of a crystallised alkaloid possessing great hæmolytic power: Th. **Bondouy**.—The colloidal properties of starch and its spontaneous jelly formation: E. **Fouard**.—The preparation of fused alumina in the amorphous state and the reproduction of the blue colour of the Oriental sapphire: Louis **Paris**. The addition of small quantities of lime (2 per cent. or less) to the alumina before fusion has the effect of retaining the blue colour due to cobalt or iron oxides. Without this addition the alumina, on solidification, is colourless, with an external, deeply coloured crust.—Comparative effects of amides as food on the development of the adult plant, the seed, and the free embryo: J. **Lefèvre**.—The presence of *Planaria alpina* in Auvergne: C. **Bruyant**.—The Plumulariidæ of the *Challenger* collection: Armand **Billard**.—A new parasite of *Œnophtira pilleriana* of the vine: Henri **Sicard**.—The extent of the possible colour changes of *Hippolyte varians*: Romuald **Minkiewicz**.—The shaping of mountain slopes: P. **Berthon**.—The stems of Clepsydropsis: Paul **Bertrand**.—The seismic disturbance of November 11, 1908: Alfred **Angot**.

NEW SOUTH WALES.

Royal Society, September 2.—Mr. W. M. Hamlet, president, in the chair.—The discharge of electricity from glowing carbon: Prof. J. A. **Pollock** and A. B. B. **Ranclaud**. The flow of negative electricity from hot carbon, in a circuit containing an air-gap, up to three millimetres in length, between a hot and a cool carbon rod, has been investigated for temperatures of the hot rod from 1100° C. to 1800° C., and for various voltages up to the point at which an arc forms between the carbons, the experiments being made in air at natural pressure. A suggestion is made as to the development of the arc from the non-luminous discharge which seems to account for the observed phenomena. The discontinuity of potential at the surface of the heated carbon, due to the projection of electrons, is found to range from 1·1 volts at 1300° absolute to 16·7 volts at 3690° absolute. From these values the velocities with which electrons are projected from hot carbon are deduced, the results being of the order of 10^8 centimetres per second.—The re-lighting of the carbon arc: Prof. J. A. **Pollock**, Dr. E. M. **Wellisch**, and A. B. B. **Ranclaud**. In connection with the re-lighting of the carbon arc, without movement of the electrodes, when the circuit is opened and re-closed, the relation between the potential difference, established between the carbons at the moment of the re-making of the connections, and the maximum time of interruption of the circuit, within which the arc will re-form, has been investigated for various conditions.—Evidence of recent submergence of coast at Narrabeen: Prof. T. W. E. **David** and G. H. **Halligan**. The general physical features of the N.S. Wales coast are described, as showing distinct evidence of recent coastal submergence. The evidence supplied by bores, shafts, &c., in . vicinity of Sydney and Newcastle, is traversed, and its bearing upon the subject of land movement is discussed. The strongest evidence of all is the

finding of an old land surface, with a mangrove fauna and fresh-water flora, at a depth of about 52 feet below high water, at Narrabeen, on the Manly-Pittwater Road. Details of this bore, put down by the authors, assisted by university students, in 1904, are given, and the conclusion arrived at that in this bore we have direct and positive evidence of a submergence of the coast-line, in the vicinity of Sydney, within very recent geological time.

Linnean Society, September 30.—Mr. T. Steel, vice-president, in the chair.—Some remarkable Australian Libellulinæ, part ii., descriptions of new species: R. J. **Tillyard.** The tendency of the Libellulinæ found in tropical Australia appears to be gradual simplification along the following lines:—abolition of superfluous nervures, loss of pruinescence, decrease in size, simplification of colour-pattern, and contraction and intensification of dark pigmentation of the wings. Eight species are added to the Australian list, of which six are proposed as new.—The life-history of *Loranthus exocarpi*, Behr.: C. C. **Brittlebank.**—Geological notes on Kosciusko, with special reference to glacial action: Prof. T. W. Edgeworth **David.** The gneissic granites of Cooma have been proved to pass in places into coarse mica-schists, and the series is classed provisionally as pre-Cambrian. Fossiliferous Ordovician rocks have been found to occur near Berridale. The origin of Lake Coolamatong is attributed to a downthrow fault. The total area covered by the ice calotte of Kosciusko was probably from 80 to 100 square miles. The ice-cap was fully twelve times as large, and at least double the thickness, formerly estimated, while the snow-line was quite 300 feet lower than at present, involving a lowering of the mean temperature by about 10° F. In more recent geological time there was another period of glaciation, during which Lakes Cootapatamba and Albina, the Blue Lake, &c., were formed.—Opsonisation from a bacterial point of view, and opsonic technique: Dr. R. **Greig-Smith.** It was found that a two days' culture of *Staphylococcus aureus* is more completely opsonised than younger or older cultures; the intraphagocytic digestion is the greater the older the culture; there is no auto-opsonic action manifest in moderately old cultures; races of different ages are opsonised to the same extent; bacteria grown upon agar are more easily opsonised than bacteria from bouillon-cultures.—Revision of the Australian Curculionidæ belonging to the subfamily Cryptorhynchides, part ix.: A. M. **Lea.** The ninth instalment of the revision deals with the genus Chætectetorus and some of its allies, of which eleven genera, including four proposed as new, and twenty species, including eight proposed as new, are described.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 26.

ROYAL SOCIETY, at 4.30.—Some Experiments made to test the Action of Extract of Adrenal Cortex: S. G. Shattock and C. G. Seligmann.—Further Results of the Experimental Treatment of Trypanosomiasis; being a Progress Report to a Committee of the Royal Society: H. G. Plimmer and Captain H. R. Bateman, R.A.M.C.—A Trypanosome from Zanzibar: Colonel Sir David Bruce, C.B., F.R.S., and Captains A. E. Hamerton, D.S.O., and H. R. Bateman.—The Proportion of the Sexes produced by Whites and Coloured Peoples in Cuba: W. Heape, F.R.S.—Further Researches on the Etiology of Endemic Goitre: Captain R. McCarrison, I.M.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Domestic Electricity Supply (including Heating and Cooking) as affected by Tariffs: W. R. Cooper.

SOCIETY OF DYERS AND COLOURISTS, at 8. Reaction between Picric Acid and Fibre Colloid: W. P. Dreaper and W. Stokes.—Colouring Matters in Sole Leather: H. G. Crockett.

FRIDAY, NOVEMBER 27.

PHYSICAL SOCIETY, at 5.—A Graphic Method of dealing with Refracting Surfaces: H. S. Allen.—A Method of Determining Moments of Inertia: The late Prof. W. Cassie.—An Experimental Examination of Willard Gibbs's Theory of Surface Condensation regarded as the Basis of Adsorption: W. C. M. Lewis. On the Diffusion of Actinium and Thorium Emanations: S. Russ.—On the Elliptic Polarization produced by the Direct Transmission of a Plane Polarised Stream through a Plate of Quartz cut in a Direction Oblique to the Optic Axis, with a Method of Determining the Error of a Plate supposed to be Perpendicular to the Axis: James Walker.

SATURDAY, NOVEMBER 28.

ESSEX FIELD CLUB, at 7 (at the Essex Museum of Natural History, Stratford.)—Report of Club's Delegate at Corresponding Societies Committee, British Association, Belfast: Prof. E. G. Coker.—The Re-afforestation of Hainhault: Francis Dent and T. S. Dymond.

MONDAY, NOVEMBER 30.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Panama Canal in 1908: Dr Vaughan Cornish.

ROYAL SOCIETY OF ARTS, at 8.—Twenty Years' Progress in Explosives: Oscar Guttmann.

INSTITUTE OF ACTUARIES, at 5.—Inaugural Address by the President, G. F. Hardy.

TUESDAY, DECEMBER 1.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: Glasgow Central Station Extension: D. A. Matheson.—*Possible Paper*: The Rotherhithe Tunnel: E. H. Tabor.

WEDNESDAY, DECEMBER 2.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Gravimetric Estimation of Antimony and Tin: E. Cahen and Dr. G. T. Morgan.—The Oil from Carapa Guianensis: Dr. J. Lewkowitsch.—The Detection and Estimation of Formaldehyde in Milk: H. S. Shrewsbury and A. W. Knapp.—The Determination of Aldehydes in Oil of Lemon: A. H. Bennett.—Some Analyses of Cream Cheese: C. H. Cribb.

GEOLOGICAL SOCIETY, at 8.—The Geological Interpretation of the Earth-movements Associated with the Californian Earthquake of April 18, 1906: R. D. Oldham.

ROYAL SOCIETY OF ARTS, at 8.—Mechanical Flight: E. S. Bruce.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, DECEMBER 3.

LINNEAN SOCIETY, at 8.—Biscayan Plankton, the Ostracoda: Dr. G. Herbert Fowler.—Note on *Juniperus taxifolia*, Hook. and. Arn.: Bunzō Hayata.—Mimicry in Spiders: R. I. Pocock.

RÖNTGEN SOCIETY, at 8.15.—Phenomena observed in Electrical Currents of Continuous Oscillation: Dr. H. Manders.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—The Influence of Track upon Railway and Tramway Carriages: J. S. Warner.

CONTENTS.

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THURSDAY, DECEMBER 3 1908.

PHYSICS, OLD AND NEW.

The New Physics and its Evolution. By Lucien Poincaré. Pp. xvi+344. International Scientific Series. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1907.) Price 5*s*.

The Evolution of Forces. By Dr. Gustave Le Bon. Edited by F. Legge. Pp. xv+388. (Same series and publishers, 1908). Price 5*s*.

MR. LEGGE is to be congratulated in bringing before the English reader these two French publications, which have been translated into vigorous and idiomatic English. The value of each book is enhanced by the addition of a table of contents and an index, and of occasional notes by the translator of explanation or of recent additions to knowledge.

The work of Lucien Poincaré is a critical statement of the position of physics to-day, with especial reference to the influence of recent discovery on the older ideas. In about three hundred pages he passes in review a great variety of subjects, including a discussion of the fundamental units, the principles of physics, the various states of matter, electrolytic dissociation, wireless telegraphy, electric conduction of gases, kathode rays and radio-activity, while two chapters are devoted to the æther and the connection between æther and matter. In such a short compass it is obvious that none of these subjects can be treated in detail, but the author succeeds in every case in giving a luminous and interesting survey of the state of knowledge. Great care has evidently been taken in studying the historical development of ideas and in endeavouring to apportion the just credit to various investigators. In this the author shows himself unusually accurate and happy in his statements. There is one notable exception to which attention may be directed. In the discussion of the principle of the conservation of energy, two pages are devoted to the contributions of Mayer, but no mention is made of the classical experiments of Joule.

The judicious attitude of the author is well illustrated in his short account of the *n*-rays and in the history of wireless telegraphy. He obviously feels that it behoves him to step warily. A digression is given on the duties of the writer of contemporary science which bears quotation :—

"An invention is never, in reality, to be attributed to a single author. It is the result of many collaborators who sometimes have no acquaintance with one another, and is often the fruit of obscure labours. Public opinion, however, wilfully simple in the face of a sensational discovery, insists that the historian should also act as a judge; and it is the historian's task to disentangle the truth in the midst of the contest, and to declare infallibly to whom the acknowledgments of mankind should be paid. He must, in his capacity as skilled expert, expose piracies, detect the most carefully hidden plagiarisms, and discuss the delicate question of priority; while he must not be deluded by those who do not fear to announce, in bold accents, that they have solved problems of which they find the solution imminent, and who, the day after its final elucidation by third parties, proclaim themselves its true discoverers. He must rise above a partiality which deems itself excusable because it proceeds from national pride; and finally he must seek with patience for what has gone before. While thus retreating step by step he runs the risk of losing himself in the night of time."

Finally, after a happy if somewhat delicate treatment of the history of the subject, he concludes with the following quotation from Voltaire in the "Philosophical Dictionary":—

"What! We wish to know what was the exact theology of Thot, of Zerdust, of Sanchuniathon, of the first Brahmins, and we are ignorant of the inventor of the shuttle! The first weaver, the first mason, the first smith, were no doubt great geniuses, but they were disregarded. Why? Because none of them invented a perfect art. The one who hollowed out an oak to cross a river never made a galley; those who piled up rough stones with girders of wood did not plan the Pyramids. Everything is made by degrees and the glory belongs to no one."

In a final chapter the author makes a few remarks on the "future of physics." He is appreciative of the great value of the electronic hypothesis, and foresees that it will lead to further developments, but is not so certain of its survival in its present form. He states :—

"The electron has conquered physics, and many adore the new idol rather blindly . . . but it is right not to lose sight of the fact that an image may be a well founded appearance, but may not be capable of being exactly superposed on the objective reality."

The book is simply and pleasantly written with an absence of all formulæ and the avoidance of technical terms as far as possible. The non-expert reader will find some of the chapters stiff reading, but he will nevertheless find much to interest and instruct. It is a scholarly production which can be confidently recommended to all who are interested in the development of physics.

The work of M. Gustave Le Bon on the "Evolution of Forces" is of a very different type. If, in reading the work of M. Poincaré, the critical faculty rests in abeyance, in the work of M. Le Bon there is an inclination to dispute the correctness of a statement on nearly every page. The work is in some respects a sequel to the "Évolution de la Matière," previously published, which gave an account of the author's views on the transformation of matter and his experiments in support of them. The present work is somewhat varied in character. The first half of the book is devoted to a discussion of the principles of physics, including the fundamental conceptions of time, space, energy, and matter, and the principle of the conservation of energy and of matter from the point of view of Le Bon's theory. This theory is engaging in its simplicity, but is in many respects very revolutionary in character. The atoms of matter, which are supposed to be enormous reservoirs of energy, are slowly undergoing spontaneous transformation into the æther. Matter represents a comparatively stable form of energy, but electricity, light, heat, &c., are unstable manifestations of the same energy, and are derived from the transformation of the atoms of matter. The terms electricity and matter

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are mutually convertible, for the appearance of electricity represents a corresponding disappearance of matter. The theories of the indestructibility of matter and energy are overthrown. All matter and energy are disappearing from the universe to be ultimately converted into æther.

The second half of the book contains an account of experiments, with numerous illustrations by the author in support of his views. Some simple electrostatic experiments are described from which he draws truly astonishing conclusions. The latter part of the book is devoted to a description of his experiments on phosphorescence and "black light." This portion of the book will be found very instructive to those who are interested in the little-known subject of phosphorescence. A number of striking experiments are described, and the author has obviously taken great trouble to make the results as conclusive as possible. The general idea is that phosphorescence is a result of the transformation of atoms of matter. There still remains much to be done in this field of inquiry, but it has not yet been proved that the molecular combinations and dissociations under the influence of light are not sufficient explanation without having recourse to the transformation of atoms.

The book is full of trenchant criticisms, and neither principles nor theories are spared which do not fall in with the author's views. We gather, whether rightly or wrongly, that the author has little respect for the orthodox man of science, whom, apparently, he considers is steeped in formulæ and filled with conservatism, but yet not so conservative that he is not capable of taking the excellent views of Le Bon without giving credit for them. We are familiar with examples of our non-mathematical scientific brethren who abhor the sight of a simple equation. M. Le Bon is evidently of their opinion, as may be seen from the following quotation, which also serves as an example of his vigorous style:—

"What has finally given very great force to certain principles of physics and mechanics has been the very complicated mathematical apparatus in which they have been wrapped. Everything presented in an algebraical form at once acquires for certain minds the character of indisputable truth. The most perfect sceptic willingly attributes a mysterious virtue to equations and bows to their supposed power. They tend more and more to replace, in teaching, reason and experience. These delusive veils which now surround the most simple principles only too often serve to mark uncertainties. It is by lifting them that I have succeeded more than once in showing the frailty of scientific beliefs which for many scholars possess the authority of revealed dogmas."

Assuming the correctness of the hypotheses and statements of the author, the book forms interesting reading, and is full of original ideas. It is a different matter when one proceeds to examine the evidence in favour of his theory. Men of science are very chary, and rightly so, of hypotheses reared on a very slender foundation of fact which endeavour to account for the universe and all that it contains. Some experimental proof is required before such hypotheses are seriously entertained. It is true that the study of the radio-active bodies has led to the belief that the atoms of active matter undergo spontaneous transformation and are the seat of a large store of energy. Many are prepared to believe that the same is true of the atoms of ordinary matter. Experiment seemed at first to indicate that all matter was radio-active, and was in a state of slow transformation. Recent work, however, has cast grave doubt on this conclusion, for it is fairly certain that the greater part of the apparent activity of ordinary matter, with the exception, possibly, of potassium and its salts, can be explained without the necessity of assuming that the atoms of ordinary matter are disintegrating. The study of the internal heat of the earth shows that if ordinary matter is evolving energy due to atomic transformation, it must do so at a rate very small compared with even a weakly radioactive substance like uranium. As Strutt has pointed out, the internal heat of the earth would be much greater than it is if ordinary matter disintegrated at even one-thousandth the rate of uranium. It is probable that the transformation of the atoms of matter may be much accelerated under the influence of exceedingly high temperature and its accompanying manifestations. It seems to have been overlooked that Sir Norman Lockyer long ago advanced this idea from a study of the constitution of the stars. The astronomical evidence in support of the view that the atoms of matter undergo transformation is collected in his interesting book, "Inorganic Evolution."

One of the main hypotheses of Le Bon is that electricity is derived from the decomposition of atoms of matter. On this view, the electricity which passes through a copper wire is derived at the expense of the copper, and ultimately the latter will vanish into a quantity of intangible æther. On account of the great store of electricity in an atom of matter, this disappearance will take place very slowly. It is now generally believed that the passage of electricity through a conductor is due to the transference of charged carriers, but it is exceedingly doubtful whether there is any loss of matter in the process. There is so far not the slightest experimental evidence in favour of the assumption.

The book is clearly written, and the interest is maintained throughout. We can recommend it to readers who are interested in revolutionary ideas of physics and in the spectacle of the *débâcle* (according to Le Bon) of a large amount of scientific doctrine. We would suggest, however, that the reader need be under no obligation to consider the statements contained in it as the latest accepted scientific gospel.

BIOGRAPHY OF SPENCER.

The Life and Letters of Herbert Spencer. By Dr. David Duncan. Pp. xi+621; with seventeen illustrations. (London: Methuen and Co., n.d.) Price 15*s*.

It is not long since we had Mr. Herbert Spencer's voluminous "Autobiography," and now we have his "Life and Letters"—a labour of love executed with marked success by Dr. David Duncan, who was for a time the philosopher's secretary and collabo-

rateur. With his characteristic deliberateness, Mr. Spencer arranged for this "Life" some twenty-eight years ago, and he confirmed the arrangement in his will. He felt that an autobiography is from the nature of the case likely to give a partial picture of the man, and this is borne out by reading the "Life." Although Herbert Spencer was unusually gifted with the power of regarding himself almost impersonally as a phenomenon, the result of the "Autobiography" was to leave some false impressions, as, for instance, that he was "all brains and no heart." Besides correcting the partiality of Spencer's self-portraiture, the "Life" contains many letters of historical interest, an important document entitled "The Filiation of Ideas" (1898–9), and valuable summings up, such as the chapter on Spencer's views on inorganic evolution. Moreover, it is the only authoritative record of the twenty-one years that elapsed after the completion of the "Autobiography."

The biographer has done his work with great skill, welding his material into a continuous narrative, and preserving throughout a keen sense of perspective. One wishes that he had not hidden himself quite so much, for he had unusual opportunities of knowing Spencer; but perhaps his very objective mode of treatment is the higher art, and in any case it is peculiarly congruent with the subject.

The fine chapters at the end of the biography which deal with "Characteristics and Personal Reminiscences" and with "Spencer's Place in the History of Thought" are less objective than the rest of the book, and will be read with great interest.

Much of the "Life" necessarily covers somewhat familiar ground, and confirms impressions which the "Autobiography" gives. Again we see how the inherited strain of nonconformity and independence expressed itself consistently throughout Spencer's life in things great and small. In 1842 a friend called him "radical all over," and it was a descendant of the man who could not lift his hat without violating his principles, that would not go to Lady Derby's "At Home," either with a levee dress or without one, to have the honour of meeting His Majesty the Emperor of Russia, and who omitted the Duke of Argyll's name from a reference in one of his pamphlets lest some people should regard him as a snob. But it was the same irreconcilable dissenter who let hardly a year pass without acting as champion of some unpopular cause, who was, where principle was involved, absolutely reckless of popularity, who did not know what it was to fear the face of man.

Again, as in the "Autobiography," the reader is surprised, sometimes even startled, by some of Spencer's judgments, both as to the work of others and his own. "I have lately been reading," he writes in 1843, "Pope's 'Homer.' . . . To my taste there is but little real poetry in it . . ." In 1852 he writes, "Though a Scotchman (and I have no partiality for the race) I am strongly inclined to rank Alexander Smith as the greatest poet since Shakespeare." We cannot but like the philosopher better when we find him telling his father, concerning the "Psychology," "My private opinion is that it will ultimately stand beside Newton's 'Principia,'" and then writing twelve days afterwards that it will be as well not to mention this opinion lest it may be thought "a piece of vanity." Perhaps there was in this some expression of the sense of humour which was so well concealed by the author of the "Synthetic Philosophy" that some who had opportunities of knowing him well have doubted whether it was not vestigial.

The "Life" tells us of much kindness on Spencer's part that the "Autobiography" could not, of course, mention, and the whole impression left is that of a much more human character. In referring to the idea that Spencer was all intellect and no feeling, Dr. Duncan points out that the letters to his parents furnish sufficient disproof.

"Rare indeed are the instances in which father and son have laid bare their minds so freely to one another. Rarer still are the instances in which father and son have for over thirty years carried on their correspondence on such a high level of thought and sentiment."

Of Spencer's capacity for strong friendship, the "Life" affords abundant illustration. In speaking of their old-standing friendship, Huxley wrote:—"It has been the greatest pleasure to me to see the world in general gradually turning to the opinion of you which is twenty years old in my mind"; and again:—"How odd it is to look back through the vista of years! . . . Considering what wilful tykes we both are (you particularly), I think it is a great credit to both of us that we are firmer friends now than we were then." "Wilful tykes" indeed, for this intimate friendship of nearly forty years' standing was almost wrecked by a hot controversy in 1889. This was a grief to both the veteran combatants, who, happily, were great enough, after some years, to shake hands and be friends again.

We hear not a little in the letters about the way in which readers in general and critics in particular "persisted in some absurd misapprehension or other," but we have not found any suggestion on Spencer's part that he might himself be in any way responsible for the misunderstandings which he aroused.

The "Life" does not weaken our impression of Spencer's almost morbid sensitiveness in regard to priority. Now it is some lecture, and again some text-book, that is at fault; at one time it is Henry Drummond, and at another time Charles Darwin, who uses, without sufficient acknowledgment (it is alleged), some conclusion that Spencer had arrived at. He was vexed that so many writers supposed that mental evolution was Darwin's hypothesis.

"As no one says a word in rectification, and as Darwin himself has not indicated the fact that the 'Principles of Psychology' was published five years before the 'Origin of Species,' I am obliged to gently indicate this myself."

In this connection the appendix containing Spencer's account of the filiation of his ideas is interesting, as is also the note in 1860 to the effect that the programme of the "System of Philosophy"

in its finished form was drawn up before he read the "Origin of Species."

It was doubtless Spencer's keen sense of accuracy and justice rather than any feeling of personal rights that made him so sensitive about priority, and it was perhaps his jealousy for the honour of science that led him to behave in a somewhat strange way concerning his election as a foreign correspondent of the Reale Accademia dei Lincei. It should be remembered, too, that while Spencer was unwilling that anyone should use his ideas without acknowledgment, he was even more troubled by the suggestion that he ever did anything of this sort himself. To be accused of cribbing from Comte was a serious charge, though absurd on the face of it; but it seems strange that he should have found it "very annoying" to be accused of stealing the idea of "the gospel of relaxation"—and the phrase as well—from an American writer. This was in allusion to his well-known thesis that "Life is not for learning, nor is life for working; but learning and working are for life"—"a strange maxim this," as the biographer well remarks, "to come from one who scorned delights and lived laborious days in order to complete a task he had deliberately imposed upon himself."

In curious inconsistency with Spencer's sensitiveness over questions of priority was his very small appetite—sometimes amounting to total abstinence—as regards the works of previous evolutionists, and in this connection the "Life" has some additional information that is instructive. Spencer went in for "little reading and much thinking, and thinking about facts learned at first hand."

"All along," he said, "I have looked at things through my own eyes and not through the eyes of others. I believe that it is in some measure because I have gone direct to Nature, and have escaped the warping influences of traditional beliefs, that I have reached the views I have reached."

As one would expect, the "Life" informs us that many of the things said about Spencer were untrue. He once said that he could fill a small volume with absurd stories about himself, and the trouble was that his high standard of accuracy led him to take them somewhat too seriously. Instead of recognising that it is one of the penalties of greatness to become a centre of myths, or contenting himself with docketing the canards as evidences of "the extreme untrustworthiness of human testimony," he was sometimes annoyed by them, and spent time in correcting them—for instance, in the case of the quite innocent statement which appeared in the *Aberdeen Free Press* that Spencer had once written articles on sociology for the Birmingham *Pilot*. As he lived a very quiet life, certainly not one that furnished picturesque copy, there was scope for inventiveness, and thus absurd paragraphs appeared to the effect that Spencer always wore white gaiters, invariably carried a bulky umbrella, lived chiefly on bread and coffee, and changed his occupation every ten minutes. Perhaps the only matter for real regret was that the inventiveness was of so low an order.

The biographer is nothing if not loyal to Spencer; he is inclined to rebut what seems to us just criticism. We cannot always agree, and we may give one example. At the close of his account of the Weismann controversy—the issue of which is so momentous in relation to Spencer's ætiology—Dr. Duncan says that it is not for a layman to express an opinion on a question that divides biologists into distinct schools. He goes on, as one usually does after this sort of bow, to express very decided opinions.

"Bearing in mind how frequently the charge of *a priori* reasoning has been brought against Spencer, one cannot help remarking on the hypothetical nature of Prof. Weismann's premises and the *a priori* character of his arguments. The demands he makes on one's credulity are, to say the least, not less numerous or less astounding than those made by the opposite school. Prof. Marcus Hartog's description of Prof. Weismann's work on Amphimixis, may be applied to the theory as a whole. It is 'a magnified castle built by the *a priori* method on a foundation of "facts" carefully selected, and for the most part ill known, misinterpreted, or incomplete.'"

This opinion seems to us erroneous and misleading. One may compare Weismann's theory of determinants with Spencer's theory of physiological units; both are imaginative constructions, and unverifiable in any direct way. Experts have to choose the one that seems the simpler, the more consistent with known facts, and the more useful in interpretation, or to refuse them both in favour of a third. But the real issue was not in regard to a subtlety of this sort; it was in great part a question of fact—is there evidence warranting a belief in the transmissibility of somatic modifications?—and as one result of the controversy no evolutionist can any longer make the Lamarckian assumption without some energetic attempt at justification.

Much of the truth which Spencer expounded has now passed into the framework of the scientific universe of discourse; part, perhaps, has still to be incorporated; and not a little, bound up with "use-inheritance," will probably have to be rejected altogether. But, in addition to the reverence and gratitude with which we regard Spencer as thinker and teacher, there must rise in the minds of all who read this "Life" a desire to join with the author in paying homage once more to "the high and indomitable purpose that sustained Spencer throughout these years, enabling him, in face of difficulties that seemed almost insurmountable, ever to keep sight of the goal."

"Take him for all in all," the biographer says, "he was intellectually one of the grandest and morally one of the noblest men that have ever lived. His life was devoted to a single purpose—the establishing of truth and righteousness as he understood them."

Finally, we would say that we have, on reading the "Life," a refreshment of admiration for one who, while he was an intellectual Alpine climber, and accustomed to altitudes where many find it difficult to breathe, yet was a citizen of the world who took much thought for the people. "Ein Kerl der speculirt" was how Huxley, quoting from "Faust,"

described him to Tyndall, but, as Mr. Courtney said in his impressive farewell address, "it must never be forgotten that his one overmastering and dominant purpose was practical, social, human." The cold agnostic, all intellect and no heart, often felt himself called upon "to suspend his work in order to try to convert Christians to Christianity," as Dr. Duncan well puts it. As old age crept on apace, and he was writing his last book, it was anxiety for the welfare of his country that alone disturbed his serenity as he pondered over "ultimate questions," and wondered "Shall I ever again be awakened at dawn by the song of the thrush?"

OCULAR PATHOLOGY.

The Pathology of the Eye. By J. Herbert Parsons. 4 vols. Vol. i., pp. xiii+388; vol. ii., pp. viii+389–770; vol. iii., pp. x+771–1128; vol. iv., pp. ix+1129–1427. (London: H. Frowde and Hodder and Stoughton, 1908.)

THE recent completion of this work, of which the first volume was published in 1904, marks an epoch in the literature of the pathology of the eye. In his preface the author states that "the object of this treatise is to give as complete an account of the pathology of the eye as is possible in the present state of our knowledge."

How closely the author has kept this object in view, and how nearly he has attained it, will be obvious to readers who are familiar with ocular pathology. In comprehensiveness, in fulness of detail, and in wealth of illustration, this treatise exhibits a notable superiority over all previous monographs on the subject.

As curator of the museum at Moorfields Eye Hospital, the author has enjoyed opportunities for pathological study and investigation which may be justly termed exceptional. Much credit is due to him for the excellent use he has made of these opportunities, and also to the hospital authorities for their enlightened policy in maintaining a laboratory in which such good and permanently valuable work can be carried on.

The need of a book such as Dr. Parsons has given us has often been felt by those engaged in the study of ophthalmology, and especially by those who are unfamiliar with languages other than English. Much good work has been done, and great advances have been made in ocular pathology during the last ten or fifteen years, but the records of these accomplishments are widely scattered in scientific journals, hospital reports, and elsewhere, and are often unobtainable by the student. No attempt has hitherto been made, at all events successfully, to produce a work dealing comprehensively with the pathology of the eye. Hence the treatise now before us supplies a real want, and will prove (indeed, has already proved) of great assistance to those interested in this branch of medical science.

The author has wisely divided his work into four parts, and has thereby given us volumes of convenient and easily portable size. We doubt if he has been as well advised in extending the publication of the volumes over so long a period as four years. As a result of this, his work has to suffer the disadvantage, common to all scientific books of protracted publication, that by the time the final volume is in print the earlier portion of the work requires revision to bring it up to date.

The plan adopted by the author has been to devote the first and second volumes to the "Pathological Histology" of the ocular tissues, and the third and fourth volumes to the "General Pathology" of the eye, this latter title having a very wide and inclusive character. This arrangement, although in many respects admirable, and possibly the most serviceable, has led to a certain amount of repetition, necessitated by the consideration of subjects under two headings. For example, if the reader wishes to look up the pathology of injuries, say, of the cornea, he will find the subject partly dealt with in the chapter on the cornea in vol. i., and partly in the chapter on injuries in vol. iv.

In vols. i. and ii. the pathological histology of the eye, eyelids, and orbit (cysts and tumours) is dealt with, each component part of the eyeball, *e.g.* the cornea, iris, lens, &c., being considered separately and very fully. As introductory to the description of the morbid histology of each structure, there is a brief but sufficient account of its normal histology. This materially enhances the usefulness of the book to those engaged in microscopic work, enabling them, without loss of time, to refresh their memory of the histology of healthy tissues, or to compare the characters of their specimens with those accepted as normal.

The bacteriology of the ocular tissues, a subject of great and increasing importance, is also included in these volumes. A brief and serviceable account is given of the established relations of micro-organisms to disease of the various ocular tissues. More than this could not reasonably be desired in a work not dealing specially with bacteriology.

The scope of vols. iii. and iv. is much wider than that of the preceding volumes, and embraces more than might naturally be expected from the title, "General Pathology of the Eye."

In addition to subjects legitimately included under this heading, vol. iii. contains a lengthy account of the normal circulation of the eye, the nutrition of the eye, and the normal intra-ocular pressure. We are unable to agree with the author's view that "it is essential to give an exhaustive account of the normal circulation and nutrition of the eye" in a work on pathology. These three chapters, excellent in themselves, are much too elaborate as an introduction to the consideration of morbid conditions, and might with advantage be greatly curtailed in future editions.

Vol. iv., in addition to chapters on injuries, orbital inflammations, sympathetic ophthalmitis, &c., contains a very instructive chapter dealing with the morbid changes in symptomatic diseases of the eye, as, for example, the ocular lesions associated

with disease of the nervous and circulatory systems, the internal organs, &c.

Its concluding chapter is on heredity in diseases of the eye. As an introduction to this subject, the author has included a brief exposition of the Mendelian theory of inheritance, taken from a paper by Mr. R. C. Punnett, in the Proceedings of the Royal Society of Medicine.

This treatise, as we have already said, is the most complete work of its kind hitherto published. In our opinion it is an extremely valuable addition to ophthalmological literature, and one which is indispensable to all those engaged in the study of ocular pathology.

There are two special features of Dr. Parsons's book to which attention may be directed. One is the admirable way in which the author brings together and discusses the various theories which at different times have been brought forward in explanation of the pathology or pathogenesis of ocular disease. A good example of this is to be found in the chapter on sympathetic ophthalmitis.

The author's decisions appear to be strictly judicial, but he is perhaps rather lenient in reference to theories or statements which have been shown to be hardly worthy of support.

The other feature is the very full and most valuable list of references to literature provided throughout the book. Following the method of a well-known writer of travellers' guides, Dr. Parsons affixes an asterisk to the works which he believes to be most important, but, like the hotels in the guide, there is sometimes room for difference of opinion as to the merits of the "starred" articles.

In its general attributes, Dr. Parsons's work deserves commendation, and very little adverse criticism is called for. The author's literary style is usually clear and decisive, though it often lacks smoothness and elegance. It is no discredit to him that in the course of so extensive a work some pages should contain a few crude or cryptic sentences. There are but few printer's errors, but some of them ought not to have escaped notice, *e.g.* the printing of the word "sarcoma" for "glaucoma" in vol. iii., p. 1072.

The illustrations, which are very numerous, are, with few exceptions (*e.g.* several in the chapter on the retina), very satisfactory. The large majority are from photographs, and have, therefore, the merit of unquestioned fidelity, even if they are less explicit (especially in high-power reproductions) than drawings.

A careful index of illustrations and of subjects is given in vols. i., ii., and iii. Vol. iv. has an index of the subjects contained therein, but lacks an index of illustrations. In this volume there is also a general index of subjects in all four volumes, but, unfortunately, it is of little use. The value of a general index in a work of more than one volume is to enable the reader to ascertain quickly in which volume he will find the subject under discussion. It is no assistance to him to learn that it is on p. 1339, unless he is informed in which volume this page is to be found.

A STUDY IN SEAWEEDS.

Die Algenflora der Danziger Bucht, ein Beitrag zur Kenntnis der Ostseeflora. By Prof. Lakowitz. Pp. vii+141; 1 Vegetationskarte, 5 double plates of photographic illustrations of the plants, and 70 text-illustrations of structure. (Danzig, 1907, Kommissions verlag von W. Engelmann, Leipzig.)

THIS monograph is devoted to a most careful study of the marine flora (excluding diatoms) of a region which, though poor in species, affords problems of great scientific interest; more especially with respect to the origin of the flora and its comparison with those of other seas. The whole number of species determined with certainty amounted to only seventy-four, including four Characeæ, but to these must be added a few others met with only in too imperfect a state to allow of determination.

Only one species, belonging to the genus Goniotrichum, is regarded as new to science, but six varieties receive mention as previously unrecorded. The species and varieties are described as they exist in the Gulf of Danzig; their environment is noted, and their distribution within and beyond the Baltic Sea is quoted from the best works. While the descriptions, analytical keys, and figures make the first part of the monograph a valuable contribution to systematic botany, a more general interest attaches to the second part, in which are treated the relations of the flora to the environment within the bay, and to the floras of other regions. The physical configuration of the region is discussed, as well as the geological structure, and the elevations and depressions which can be traced as having occurred in the past.

There is evidence that the district lay under the Scandinavian ice-sheet for a time, and that, as the ice retreated northwards, the connection of this sea was with the cold northern seas, over sunk portions of what is now Sweden, Arctic Mollusca (*Yoldia arctica*, *Astarte borealis*, &c.) being characteristic of its fauna. The melting of the ice led to the formation of a sea with very cold water, poor in the usual marine salts. It appears to have been shut off from the present west part of the Baltic by a ridge passing through Bornholm. During this period probably the bulk of its fauna and flora arrived, about one-half of the Algæ showing an Arctic character. Subsequently, for a time, the eastern Baltic became a lake, to be afterwards again connected with the North Sea, but by a more southern outlet. The degree of salinity varied much in consequence of geological changes, which must have greatly affected the flora. Its poverty in species is very marked when compared with the 255 species recorded from the western Baltic, which has long been united with the North Sea, as at present. The less salinity has prevented the immigration of some species; and is probably the cause of physical peculiarities in others, such as the slender forms and smaller size. The Danzig algal flora tends to be characteristic of brackish water rather than of the sea. Several species are of

markedly boreal aspect, though probably immigrants, at the close of the Ice age, by way of the North Sea, over the sunk portion of Sweden. The var. *arctica*, Harv., of *Sphacelaria racemosa*, Grev., is of peculiar interest near Danzig, as it now occurs elsewhere only in the Arctic seas and on the coast of Scotland, and is not known from the south-western part of Norway or from Sweden. A full enumeration of sources of information adds to the value of an excellent piece of work.

OUR BOOK SHELF.

The Soil. An Introduction to the Scientific Study of the Growth of Crops. Second edition, revised and enlarged. By A. D. Hall. Pp. xv+311. (London: John Murray, 1908.) Price 5*s.* net.

The fact that a second edition of this book is necessary is a welcome evidence of the increased attention which is being paid to the study of the soil and also of the undoubted value of the work. This edition has evidently been most carefully revised in the light of modern investigation, and is an accurate record of existing knowledge on the soil considered from its mechanical, chemical, and biological aspects. Ten years ago we were almost entirely indebted to American or German workers for any scientific monograph on the soil, then only considered from its physical and chemical aspects, but in this work we have in addition a most valuable chapter on the functions of bacteria and fungi in the soil, in which a well balanced judgment is pronounced on certain recently much advertised work which has not yet received the sanction of scientific opinion or even a trustworthy confirmation of its accuracy by practical men.

Mr. Hall's book is not only for the scientific student of soil problems, who can, by the use of the bibliography in the appendix, become familiar with the most important research on the subject, but the practical man will find a very considerable portion of the book of interest and value to him, and the carefully reasoned conclusions will assure him of the reliability of the recommendations. The chapter on soil analysis shows the attempts which have been made to evolve an official method, and it is to be hoped, for the sake of those who often have to compare and argue from analyses made by different workers (in which the personal element must always be an important factor), that the methods which have been selected after most careful consideration may be generally adopted. Mr. Hall has a special faculty for drawing from the almost inexhaustible store of the Rothamsted treasure-house results which illustrate or emphasise his conclusions, and he has the rare quality of clothing figures and tables with interest. The mechanical effect of fertilisers on the flocculation of clay and the consequent alteration in texture are well illustrated by both Woburn and Rothamsted results, and the theory that the "saddening" effect of such fertilisers as nitrate of soda is due to the presence of common salt and to the hygroscopic character of the nitrate of soda is shown to be only true to a limited extent, the main cause being the deflocculation of the clay aggregates.

We would also commend this book to the attention of science masters in secondary schools, for much of its contents could, with senior students, be utilised both for direct instruction and also for exemplifying, in a substance with which everyone must be more or less acquainted, many of the laws of physical and chemical science.

M. J. R. D.

The Stars of the Year. By H. P. H. Pp. 23. (London: King, Sell and Olding, Ltd., *Knowledge* Office.) Price 1*s.* net.

Star Calendar for 1909. Edited by H. P. H. (London: Hirschfeld Brothers, Ltd.; Glasgow: A. Stenhouse.) Price 1*s.* net.

The Star Almanack, 1909. By H. P. H. (London: King, Sell and Olding, Ltd., *Knowledge* Office.) Price 3*d.* net.

The first of these three publications forms a useful handbook for those people who, unacquainted with the oldest of the sciences, take some kind of interest in the stars and other celestial phenomena. A brief introduction of five pages form a *hors d'oeuvre* calculated to whet the appetite for a more serious study of astronomy, and gives a few facts relating to the constellations, stars, meteors, comets, &c. Then follow twelve circular charts showing the arrangement of the constellations in the sky at 10 p.m. about the middle of each month. These charts have a blue background with white figuring, the zenith being placed at the centre, and they are very clearly printed. Beginners should find little difficulty in locating the various groupings after studying the current chart. It should be noted that on p. 8, where the constellations of the Zodiac are given, Aquarius is wrongly placed before Capricornus.

On the "Star Calendar," consisting of four cards tied together, the charts are so combined as to give the constellations for each quarter, whilst brief notes describe the positions of the planets. The calendar is of a convenient size ($15'' \times 12''$), and, being printed in colour with the conventional representations of the zodiacal signs, forms quite a decorative wall-hanging.

In addition to the four quarterly charts, the "Star Almanack" contains a deal of useful information concerning the planets, standard times, comets, meteor showers, &c., also portraits of Sir William and Lady Huggins and a reproduction of Ritchey's Andromeda nebula photograph, whilst a drawing by Mr. T. E. Heath illustrates the conception of a limited universe, ellipsoidal in form. The almanack would, no doubt, prove interesting and instructive if prominently displayed in the class-rooms of elementary schools.

In the first few copies issued of both "The Stars of the Year" (p. 7), and "The Star Almanack," there occurred a slip which gave the earth's orbital velocity as its velocity of rotation. In the later issues the latter is given correctly, and the publishers offer to exchange uncorrected copies returned to them.

W. E. Rolston.

Diptera Danica. Genera and Species of Flies hitherto found in Denmark. By William Lundbeck. Part ii., Asilidæ, Bombyliidæ, Therevidæ, Scenopinidæ. With 48 figures. Published at the expense of the Carlsberg Fund. (Copenhagen: G. E. C. Gad; London: W. Wesley and Son, 1908.)

This useful and carefully written fauna commences with a lengthy account of the structure and habits of the interesting family Asilidæ, or robber-flies, as the American entomologists call them. The author is inclined to believe that the powerful beak with which they attack their prey carries a poisonous secretion, but this remains to be proved by further observations. The systematic portion of the work is well done, the subfamilies, genera, and species being tabulated as well as described. The figures represent details, such as the head, antenna, or wing of various species, and full information is given as regards structure, habits, larvæ, distribution in Denmark and elsewhere, &c. One of the largest and handsomest of the Asilidæ, in Britain and Denmark, is *Asilus crabroniformis,* which is remarkable for its black and

yellow colour, which gives it the distant resemblance to a hornet from which it derives its name, but this is confined to its colour, for the long, tapering Asilus differs altogether in shape from a hornet.

The species of the next family, Bombyliidæ, are stout and hairy, and those of the typical genus Bombylius have a remarkable resemblance to small Bombi (humble-bees), from which, however, the two wings and the long straight proboscis at once distinguish them. The two remaining families dealt with in this volume are of small extent, and perhaps of less interest than the two first. The Diptera are a somewhat neglected order of insect, but are more studied now than formerly, and we are sure that Prof. Lundbeck's work will be found very useful to English entomologists, for whose benefit it is written in their own language. The order Diptera is probably the largest of the seven great orders of insects except the Hymenoptera, and we wish Prof. Lundbeck long life that he may be able to complete the work which he has so well begun.

Moving Loads on Railway Underbridges, including diagrams of Bending Moments and Shearing Forces, and Tables of Equivalent Uniform Live Loads. By H. Bamford. Pp. iv+78. (London: Whittaker and Co., 1907.) Price 4s. 6d. net.

THIS is a reprint in book-form, with additions, of a series of articles which appeared in *Engineering* in the autumn of 1906. Those who have had any experience of such work will know how tedious is the process, as usually conducted, of determining the maximum straining actions on a railway girder supported at the ends, due to any given type of train load, and will appreciate the methods here given, which are characterised by directness, simplicity, and comparative brevity. The author uses analytical computation with systematic tabulation, and also, as an alternative method, graphical diagrams based on a clever adaptation of the ordinary bending and shearing force diagrams. By one or other of these methods, and especially the latter, the "equivalent" uniformly spread loads for both maximum bending moments and shearing forces are quickly and easily determined. The investigation is limited to the force actions on the bridge taken as a whole, and does not consider separately the resistances offered by the platform and main girders, but so far as the subject is dealt with the author is to be congratulated on having produced a most useful and practical work.

Practical Floor Malting. By Hugh Lancaster. Pp. iv+211; with numerous illustrations. (London: *The Brewing Trade Review,* 1908.) Price 12s. 6d. net.

CONSIDERING the economic importance of floor malting in this country, it is somewhat remarkable that no work on the subject possessing any claim to thoroughness has hitherto been published. We hoped to find that the present book filled the void, but although it is a useful addition to the literature of malting, it cannot in its present form be regarded as a complete technical treatise on the subject. The author is evidently thoroughly conversant with the practice of floor malting, but owing, presumably, to lack of literary experience, he has not done justice to his knowledge, and the book is marred by many signs of hasty writing. As it stands, however, the work is distinctly a useful one, and we have nothing but praise for the ten collotype plates it contains which illustrate the differences existing between the various types of barley employed in malting. These plates are of exceptional merit, and add very much to the value of the book from a technical point of view.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Students' Physical Laboratories.

IF a protest is not made, I see some danger of the pioneer work done towards organising physical laboratory work for students in University and King's Colleges in London being inadvertently ignored, and everything of that kind attributed to Finsbury. Probably, indeed, the sound work unobtrusively done in early days is known to very few. Allow me to say, therefore, from personal knowledge, that students were admitted to physical laboratory work in these colleges before 1872—in one of them, I believe, in 1866—and that the course of quantitative laboratory instruction through which I was myself put by Prof. Carey Foster, in topographical circumstances of some difficulty, was of high value; and, indeed, reached a standard of accuracy not readily eclipsed in any students' laboratory with which I have since become acquainted.

To take a single instance, Carey Foster described his "bridge" method in 1872, and students were regularly familiarised with it. I remember also making a series of well-designed experiments on moments of inertia, on the kinetic torsion of wires, and on determinations of *g* by falling bodies and chronograph as well as by pendulums. We also used to measure E.M.F. by the potentiometer method, then called Poggendorff's; while other practical subjects were conduction of heat, rates of cooling, specific and latent heats, on the lines of Regnault; absolute density of liquids, by weighing in them a gauged ivory sphere, density of gases, &c.; a long series on magnetic moments and terrestrial magnetism in the light of Gauss's theory; the usual optical measurements and some less usual; Siemens's pyrometer (then under test for a British Association Committee); much work with a tangent galvanometer and resistance boxes—then comparatively new—on Ohm's and Joule's laws; measurements of electrochemical equivalents, &c., &c.; all before 1875. In one of the last-mentioned determinations a platinum basin was used and a weighable deposit obtained, very much on lines afterwards rendered secure and classical by Lord Rayleigh.

Indeed, I went through most of the things done in laboratories to-day which do not involve instruments of more recent date, and in 1875 we published a joint paper, "On the Flow of Electricity in a Plane," wherein the equipotential lines were plotted by an experimental method handier and more accurate than had been possible in previous observations of the kind—a method invented entirely by Carey Foster (see *Phil. Mag.*, December, 1875, §§ 47–50, with an incomplete continuation in 1876).

It is true that in those days attention was paid to the principles of pure physics rather than to technology; and undoubtedly, as technical work became prominent, other laboratories went far ahead in such subjects as the design of practical measuring instruments and in facilities for large-scale work.

But without suggesting for a moment that a word too much has been said in praise of the energetic pioneers in the field of practical work and electrical engineering, it will I feel sure, be admitted that to say (as on p. 74) that before 1875 only five persons had experimented in electricity in Great Britain, that the Finsbury system was radically different from anything which previously existed, and that before 1879 professors had merely shown experiments at the lecture table, is to make statements which involve a considerable amount of exaggeration, and unintentionally misrepresent the facts.

I take it that the novelty at Finsbury chiefly lay in the permanent installation of a number of ingenious appliances, whereby a crowd of evening students could be put through a useful course of practical work, such as would give them some preliminary idea of measuring physical quantities, and infuse their otherwise abstract notions with something definite and concrete, without the necessity for periodical preparation and clearing away by an impracticably large assistant staff.

But since the students to be educated at Finsbury were largely of the higher artisan class, or at any rate were already familiar with machinery, perhaps I should rather put the matter conversely, and say that the object aimed at was to coax their already too material and concrete ideas towards something more generalised and abstract, by analysing into simplicity the complex machines with which many of them in their daily life had to deal, thus assisting them to grasp something of the theoretical physical principles underlying them all.

An admirable object, excellently carried out! Not a word have I to say towards minimising it: only do not let us minimise the work of others either.

November 21. OLIVER LODGE.

Apparent Decay of Radium.

I WISH to put on record an observation relating to the amount of "electrolytic gas" obtainable from a solution of radium bromide. Some four years ago, about 172 milligrams of radium salts, of which 152 were bromide and 10 sulphate, were enclosed in four small bulbs along with water, which dissolved the bromide, and in which the sulphate was suspended. These bulbs were sealed to a small Töpler pump, and for three years the mixed oxygen and hydrogen gases were pumped off at short intervals—about four days between two extractions. With the emanation accompanying this mixture various experiments were performed, an account of which has appeared in the Proceedings of the Royal Society and the Transactions of the Chemical Society.

In November, 1907, I received from the Vienna Academy what was supposed to be 0·5 gram of pure radium bromide; I was told that that was its weight in 1905. It weighed on receipt only 0·388 gram. This substance was washed into a bulb, and sealed to the pump, along with the other bulbs. The amount of gas collected from the larger quantity, however, did not appear to be proportional to its greater weight, and as analysis of a sample showed that it consisted largely of carbonate, insoluble in water, it was resolved to convert the carbonate into bromide by introducing into the bulb with a pipette some pure hydrobromic acid. (I may mention, parenthetically, that the small sample, converted into bromide, gained in weight to such an extent as to show that the original amount must have weighed 0·4971 gram, as $RdBr_2,2H_2O$.) The gas pumped off after this addition of hydrobromic acid contained much free bromine, but after a few weeks the evolution of bromine ceased, and "electrolytic gas" was produced to the amount of about 30 c.c. a week, always mixed with a small excess of hydrogen. This regular evolution continued from February until November 11. On that day the usual 30 c.c. of gas were pumped off; I have a note that "an unusually small quantity of hydrogen remained after explosion." On November 18 the gas was again pumped off; the quantity was approximately 13 c.c. Although it appeared unlikely that the tubes and taps should have been blocked, it was still possible. On November 25 the gas was again removed; its volume was about 1·5 c.c. At this stage air was admitted into the pump and the connected bulbs, and it was proved that there had been no stoppage. Advantage was taken of this to clean the pump and the connecting tubes, and to re-grease the stop-cocks. The air was then removed completely by pumping. To-day (November 30) the gas was again pumped off; its volume was about 0·5 c.c. It still exploded, and left about half its volume of excess hydrogen.

Two alternative suppositions suggest themselves:—either the radium bromide, of which the apparatus contains 0·5071 gram, implying 0·2716 gram of metallic radium, has practically ceased to decompose water (about 25 c.c. of solution are present in the bulbs), or the reverse reaction, viz. the velocity of combination of oxygen and hydrogen to form water, has increased to such an extent as to reverse the decomposition.

It has been assumed that the life-period of radium is very long, say 2000 years, although Mr. Cameron and I, by measuring what we believe to be the true volume of the emanation, arrived at a considerably shorter period. Here, however, appears to be, on the first alternative, a proof that one of the ways in which the radium expends at least a portion of its energy has been stopped. It would be interesting to know if the other ways, say the evolution of heat or the emission of "rays," are similarly affected by time. WILLIAM RAMSAY.

University College, November 30.

Production of Helium from Uranium.

IN a paper in the October number of the *Philosophical Magazine* of this year I gave a preliminary account of some attempts to detect and measure the production of helium from the primary radio-elements, on which I have been engaged since 1905. The results given were few, and referred mainly to the element thorium. The following further results, obtained since the publication of the paper, with the element uranium carry the subject a stage further. The method is described in detail in the paper referred to. By special arrangements the solutions of the substances employed can be freed absolutely from air, and maintained in this condition indefinitely. After any desired period of accumulation the gases can be completely expelled by boiling the solution in a stream of gas from a voltameter. The expelled gases are freed from water by cooling, and then subjected to the action of the vapour of calcium in a special vacuum furnace, whereby all but the inert gases are perfectly absorbed. After cooling the furnace is filled with mercury, and the residual gas, if any, compressed into the smallest possible spectrum tube of lead glass. The minimum quantity of helium detectable in a successful experiment has been found by repeated trial to be 2×10^{-10} gram. Blank tests with a similar apparatus containing sodium sulphate solution were performed, and I feel confident that the data obtained are trustworthy.

I have used two separate quantities of uranium nitrate. The first and smaller had been carefully purified by Mr. T. D. Mackenzie by extraction with ether. It contained 340 grams of the element uranium. When it became evident that the rate of production was too slow to be conveniently estimated with this quantity, a second experiment on a much larger scale was started. The cost of this and similar other large-scale experiments was defrayed by a research grant from the Carnegie trustees. Four kilograms of uranium nitrate of good commercial quality, which had been re-crystallised from water, were employed. It contained 1850 grams of uranium. The preparation of the experiment and complete removal of air were effected by August 15 of this year. The first test for helium was performed after a period of sixty-one days. Helium in several times the minimum quantity detectable by the method employed was proved to be present in the extracted gases. The second test was performed after a period of twenty-seven days. Helium was again present, this time in quantity not much, if any, greater than the minimum detectable. The next test was performed after twelve days. No helium could be detected, although the experiment was a singularly perfect one. An experiment was then performed with the smaller quantity of uranium after a period of accumulation of 128 days. Helium was clearly detected, and its quantity estimated to be not greater than 1·5 times the minimum quantity.

The production of helium from uranium may therefore be considered to be established. With regard to the rate of production, the experiments show that this cannot be far from $2\times10^{-12}(\text{year})^{-1}$. That is to say, about 2 milligrams of helium are formed per year per million kilograms of uranium. The second test referred to shows that the rate is not less than 1·5. The third test shows that it is less than 3·3. The last test with the smaller quantity shows that the rate is not less than 1·7, and probably not greater than 2·5. It is of interest to note that the theoretical rate of production I recently calculated from the disintegration theory is $2\times10^{-12}(\text{year})^{-1}$, on the assumption that one atom of uranium produced but one atom of helium. These measurements, therefore, lend no support to the view, discussed in the paper referred to, that uranium on disintegration expels two helium atoms.

I may mention that I have commenced the observation of a quantity of sylvine (potassium chloride), one of the minerals investigated by Strutt, and regarded by him as exceptional in containing helium which cannot be ascribed to known radio-active changes. The tests so far indicate that the rate of production of helium from this substance, if any, is below $2\cdot5\times10^{-12}(\text{year})^{-1}$.

University of Glasgow. FREDERICK SODDY.

An Annotated Copy of Newton's "Principia."

On April 2 of this year (vol. lxxvii., p. 510) I contributed to your columns a short account of an interesting copy of the original edition of the above work, which I had purchased in Sydney from among a collection of old books that had remained packed up in cases for about 140 years, and had formed part of an English estate in Chancery. The most interesting feature of the book consists of several pages of manuscript corrections for a second edition, and numerous amendments of the mathematical diagrams throughout the book, which, according to a further note forming portion of the manuscript pages, were in the handwriting of Sir Isaac Newton himself.

The note in question referred to a manuscript work on "Optics," by Sir Isaac Newton, said to be deposited in the library of Trinity College, Cambridge, as affording an opportunity for comparison of the handwriting. I stated, further, in the letter referred to, that I had had the first two pages of the notes photographed, and had forwarded them to the librarian of Trinity College for the purpose of making such a comparison. Six months have now elapsed, and my inquiry has been followed by developments, some of which must afford interest to mathematical and astronomical students.

Within a few weeks of my communication with the librarian of Trinity College, that gentleman wrote to me to say that the manuscript volume of Newton's "Optics" was, as stated in the note referred to, lying in that library, but that it was in the handwriting of Dr. Roger Cotes, who had edited and supervised the printing of the second edition of the "Principia." He thought that the supposition that the handwriting in the notes was that of Newton was based on the belief that the manuscript "Optics" was in Newton's handwriting.

So the matter was left, when you forwarded to me a long and learned letter which had been sent to you by Dr. J. Bosscha, of Haarlem, in which (after reviewing my account of the volume and the manuscript notes) the following proposition is put forward and supported:—

"The copy now in the possession of Mr. Bruce Smith was indeed once owned by Newton. This illustrious author put it into the hands of 'his trusted suitor,' Nicolas Fatio de Duillier, who intended to publish the second edition of the 'Principia.'"

The letter in which this conclusion is made and supported is too long for quotation, but it enters into great detail with regard to the handwriting, expressing the opinion that the notes are written partly in Sir Isaac Newton's hand, and partly in that of Fatio.

A careful reference to the book shows that there are two distinct sets of corrections—one set being carefully noted and collected in the five blank pages at the beginning and end of the volume, the other set consisting of corrections in the margin of the text itself, and in the diagrams to which that text refers. The two sets of corrections certainly seem to have emanated from different minds, for those notes in the margins and diagrams are not referred to in the five pages of corrections, and those included in the five blank pages of the volume are not carried out in the text, suggesting, as Dr. Bosscha has conjectured, that one set had been prepared by one person, and the other by another. This fact is very suggestive of the double authorship of the notes, and of the authenticity of the volume, remembering that Dr. Bosscha has never seen the book, and depends upon historical records for his knowledge of the notes.

According to Dr. Bosscha, these corrections were well known, and formed the subject of correspondence between Fatio and Huygens, or Huyghens (the celebrated Dutch natural philosopher), in 1691, and Mr. Bosscha adds that Sir Isaac Newton adopted some of Fatio's corrections and rejected others, adding some more of his own.

These facts, sufficiently interesting by reason of Sir Isaac Newton's eminence and the epoch-making character of his work, seem to fit well with the character of the alterations in the volume in my possession, which, as I have said, Dr. Bosscha, of Haarlem, could never have seen.

BRUCE SMITH.

Parliament House, Melbourne.

The Semi-diurnal Barometric Oscillation.

With reference to the note in NATURE of November 12 (p. 47) upon the semi-diurnal pressure variation, it seems to me that the temperature variation is far more likely to be the result of the pressure variation than its cause. At all events, the pressure variation, however it may be produced, must of necessity lead to a temperature variation, but the converse of this proposition is by no means certain. It seems to be admitted that the atmosphere, as a whole, has a natural period of oscillation not differing greatly from twelve hours, and, that being so, a very trifling force with the same period will suffice to produce the observed phenomena. Is it possible that the earth may encounter sufficient resistance to motion in its orbit to provide this force? If we could assume the æther to act as a perfect fluid, we should have increased pressure at the front and back, using the term with regard to the direction of the orbital motion, and decreased pressure over the intermediate great circle. The direct pressure due to the resistance would have maxima at 6 a.m. and 6 p.m., whereas the barometric maxima occur about 10 a.m. and 10 p.m., but I do not think this is a serious objection.

W. H. DINES.

Watlington, Oxon, November 23.

The Fauna of the Magellan Region.

In the very interesting review of the "Ergebnisse den Hamburger Magalhaensischen Sammelreise, 1892–3," in NATURE of November 19 (p. 82), the reviewer refers to "an interesting fresh discovery . . . of numerous brood pouches (ectodermic invaginations of the body wall) in *Condylactis georgiana*," an Antarctic actinian. I have not a copy of the report to hand, but, if I remember correctly, Carlgren here gives no figures of these "brood chambers," but describes them as of similar character to those he figured in a preliminary note on the occurrence of breeding chambers in actinians published in 1893, of specimens taken by the *Vega* expedition in Arctic seas.

Here he shows that each invagination, although at first affecting the ectoderm only, may be enlarged by the gradual growth of the embryo so as to involve all three layers of the body wall—ectoderm, mesoglœa, and endoderm. Since then I have described three other species from the *Southern Cross* and the *Discovery* Antarctic collections having "brood chambers" as distinct sacs projecting into the gastric cavity, formed by the invagination of all *three* layers of the body wall.

JOSEPH A. CLUBB.

Free Public Museums, Liverpool, November 23.

A Disclaimer.

In NATURE of November 26 Mr. Soddy asserts, first, that his name as co-editor of *Ion* was made use of without his consent; secondly, that his first intimation of the appearance and of the contents of the journal was obtained from the advertisement in NATURE of November 12. These assertions contradict the actual facts of the case.

It is true that Mr. Soddy did not see the cover before publication; but that Mr. Soddy had not authorised the use of his name as co-editor does not tally with the fact that he made no objection to the wording of certain circulars sent him some time ago, the receipt of which he acknowledged in a letter of September 15. On these circulars he was expressly termed one of the editors. In a correspondence ranging over two months before the publication of *Ion*, Mr. Soddy wrote not a word against the wording of these circulars. Moreover, in his letter of September 25 he expressly desires that I should spare him as much of the editorial work as possible, as his time was limited. I thought I should be granting his request by not submitting to him the personal reports of prominent men of science, which, moreover, I, in my capacity as editor, should have included. I may take this opportunity of adding that Mr. Soddy never had any manner of participation in the journal. It will be evident that his secession will offer no hindrance to the continuance of the journal.

CHAS. H. WALTER

16 Heathfield Gardens, Turnham Green,
London, W., December 1.

TWO GIFT-BOOKS ON GEOLOGY.[1]

IT may be presumed that both these antedated works are intended for the Christmas season, and their print, illustrations, and binding make them highly attractive as gift-books for the young. Both, however, contain matter based on recent observation, and both will probably bring the results of research before many who have no acquaintance with scientific journals. There was a delightful book, entitled "The Wonders of the World," published somewhere about the time of the battle of Waterloo, which we used to read side by side with Brewster's "Natural Magic." It is more to the point to say that to this book Charles Darwin owed his earliest inspiration. Mr. Grew's far handsomer volume shows how far we have progressed in style and picturesqueness; but it depends equally on its fascinating appeal to what the earth is actually doing. Some of the examples of natural processes necessarily remain the same, but Lisbon and Calabria are now overshadowed by San Francisco and the Montagne Pelée. A fine series of photographic plates, mostly from Messrs. Underwood's well-known American series, has been chosen to illustrate the phenomena described. Extinct animals, mainly from Miss Woodward's skilful drawings, which were first published in Knipe's "From Nebula to Man," are used to emphasise the romance of palæontology.

Many of the chapters, such as viii., ix., x., xi., and xvi., are somewhat speculative for a work that seeks to convince the reader of the romance of ordinary things. In chapter xvi., on volcanoes and mountain formation, views are propounded that still require a great deal of thinking over, and in chapter xiv. we are not sure that the author distinguishes between volcanic accumulation and elevation of the ocean floor. Matters are clearer in the pages dealing with the long history of life upon the globe, though there is still a tendency to dwell on the uncertain rather than on the known. This is seen in the attempts to picture the geography of past geological periods; what evidence have we, for instance, for any of the statements on p. 211? Does the author really mean that Ben Nevis and the Pennine Chain, to mention two of the details, stood above the sea in late Silurian times?

The note of modernity struck in the second chapter by the introduction of the pear-shaped earth is maintained in the twenty-second chapter by the account of the rise of the proboscideans. The literary style is so direct and agreeable that few will open the book without wishing to read further, and some may be led on to borrow from a library the old classics of geology, which are less "modern," but on which we all are glad to build.

Mr. Scott Elliot's book follows aptly on that which narrates the building of the world. "The Romance of Early British Life" is cleverly written by means of a series of stories, in which the manners of successive peoples are rendered with the insight and humour of a Dutch *genre* painter, and yet with the sober references to authorities that befit a man of science. Such a book, cheerful and romantic as it is, has involved a wide extent of reading. Incidents and evidences are gathered from archæological journals, and appear quite naturally in their places as parts of a connected tale. This, like the sad fate of Bardolph, is in the true Shakespearean manner. We do not like the names, such as Eolithicus and O'Wookey, selected for primeval savages, but none of their real titles have come down to us. Mr. Jack London, whose modern seamen often realise the savage, has, of course, done far better in his vivid perception of the Stone age; we may all the more congratulate Mr. Scott Elliot on having given us an independent and convincing picture. On p. 29 he states that Eolithic man, whom he has shown as terribly individualistic, "nearly carried out, as only a society of squirrels and hedgehogs could do, the beautiful ideals of modern Socialism." This is indeed a puzzle, as is the equally unnecessary reference to the editors of radical newspapers on

Eruption of Mount Asama, Japan. From "The Romance of Modern Geology."

[1] "The Romance of Modern Geology: describing in Simple but Exact Language the Making of the Earth, with Some Account of Prehistoric Animal Life." By E. S. Grew. Pp. 308. (London: Seeley and Co., Ltd., 1909 [actually September, 1908.]) Price 5*s*.

"The Romance of Early British Life from the Earliest Times to the Coming of the Danes." By G. F. Scott Elliot. Pp. 358. (London: Seeley and Co., Ltd, 1909 [actually September, 1908.]) Price 5*s*.

p. 212. It requires a Charles Kingsley to carry such remarks off lightly. The Romans in Britain are shown in the usual colours, but we must remember that even the modern English are not loved as predominant partners and invaders. The Mediterranean race, however, here styled Picts, comes off fairly well, even when invading; but we fancy that too little credit is given to it for moulding the so-called Celtic modern Irishman.

The spirited illustrations, by Messrs. L. Speed and J. F. Campbell, will favourably attract the eyes of parents and guardians. The map of Britain opposite p. 226 contains too great a mixture of languages, and does not give a picture of any special epoch. This, however, can be remedied in school libraries, and we confess that we should like to conduct a class through Mr. Scott Elliot's volume, with the aid of a good atlas and a fortnight of excursions in the field. Those would indeed be happy days for all of us.

G. A. J. C.

THE ARCHÆOLOGICAL SURVEY OF NUBIA.

THE objects of the archæological survey of Nubia which has been undertaken by the Government of Egypt are, first, to ascertain the extent and value of the historical material buried under the soil; secondly, to make this material available for the reconstruction of the early history of that country and of its relations with the Nile valley. There is reason to believe that in the pre-dynastic period Lower Nubia formed with Egypt a single region of culture, and possibly a single ethnological district. Later on the northern lands developed more rapidly, and Nubia failed to keep pace with Egypt. At any rate, when the Egyptians pushed southwards under the twelfth dynasty, some of the products of Nubian civilisation are found closely to resemble, in technique and material, products of the pre-dynastic age common to both countries. The present survey aims at reconstructing the culture development of some fifteen centuries of Nubian civilisation which at present are a blank.

The first and second Bulletins, recently issued, supply a preliminary account of investigations in the district which, owing to the re-modelling of the Aswan dam, will now be permanently submerged. This archæological material would, in default of such an inquiry, have been permanently lost to science.

The survey illustrates the variety of races and culture which prevails within this area. We have a succession of interments starting from the archaic period through post-Roman, Christian, and Moslem times. The extensive denudation which has occurred has exposed the burials of the earliest age. One group of later graves contains a number of male negro bodies, most of whom met their death by hanging or decapitation—doubtless the record of a tragedy which followed one of the local revolts so frequent during the Roman or Byzantine occupations of the country.

The survey of these cemeteries, conducted by Dr. G. A. Reisner, is supplemented by a very valuable anatomical report by Drs. Elliot Smith and F. Wood Jones, which illustrates the complexity of the ethnological materials now under detailed examination. From the earliest predynastic times down to the early dynastic, the whole region, according to Dr. Reisner, was characteristically Egyptian in culture; and the race occupying it is believed by Prof. Elliot Smith to be pure Egyptian. At a later period the population became isolated from Egyptian influence, and therefore assimilated Negroid elements. We find some contracted burials of the Egyptian predynastic period, corpses of pure and half-bred negroes, while the majority of the bodies examined conform to a quite different physical type, the origin of which we have to seek in Syria and the south-eastern shores of Europe. The remains are in most cases excellently preserved, being packed with salt and fruits of certain plants not yet identified, and then wrapped in coarse cloth. Some of these persons, even one who bore on his arm a wooden cross as the emblem of the Christian faith, had been circumcised. Other interments, again, appear from the anatomical evidence to represent family burial places, the structural identity of the occupants being remarkably apparent. In one case, that of a young woman, the cause of death was plainly appendicitis; in another, long-standing pleuritic adhesions, and in a third osteo-arthritis, so-called rheumatic gout, were identified. This is the disease which shows itself with the greatest frequency in the bodies of all periods. The older skulls show no signs of dental caries, except in the case of the "milk" teeth of three children, which is believed to be the first recorded occurrence of dental caries in an ancient Egyptian or Nubian under the age of sixteen; but this is common in the foreign Christian group. The discovery of a case of tuberculosis in the Biga cemetery is exceptionally interesting, the only other known early Egyptian instance of this disease being that of a corpse of an infant from the ancient Empire burying-ground at the Giza pyramids, which presented the typical lesion of advanced hip disease which may have been of the tubercular type. But this is not quite certain, because tubercle bacilli have not been as yet definitely traced, and Dr. A. R. Ferguson is disposed to doubt the diagnosis of tubercular lesions. The same is the case with syphilitic lesions. Dr. Elliot Smith has never observed a case in ancient Egyptian bones, and regards most of the instances hitherto reported as due to the post-mortem destruction of the bones by beetles. It is also remarkable that there is no occurrence of tattooing so common in modern times, nor of the custom of skin gashing, which is almost universal in Nubia and the Sudan at the present time.

The present Bulletin is intended merely to describe some of the facts which have been elicited in the course of a summary investigation of the great mass of ethnological material unearthed by Dr. Reisner. It will be followed by a detailed archæological and anatomical report, the appearance of which will be awaited with interest. Meanwhile the anatomical and craniometrical observations by Dr. Elliot Smith, and Dr. Wood Jones's pathological report, supply a large amount of fresh anthropological material.

The Government of Egypt deserves congratulations for the initiation of a most important survey, which will supply abundant materials from which the archæological and ethnological conditions of a hitherto unexplored region can be safely reconstructed.

HIMALAYAN PHYSIOGRAPHY.[1]

IN response to a proposal made in 1906 by the "Board of Scientific Advice" to the Survey of India that a paper should be compiled "summarising the geographical position of the Himalayas and Tibet" for the benefit of travellers in those regions, a series of papers on these parts has been issued which is not only of great scientific value in itself, but will surely answer the purpose of directing scien-

[1] "A Sketch of the Geography and Geology of the Himalayan Mountains and Tibet." By Col. S. G. Burrard, R E., F.R.S., and H. H. Hayden. (Calcutta: Superintendent of Government Printing, 1907.) 5 Parts, price Rs. 2 each.

tific research towards the elucidation of many problems which beset the study of high altitudes.

The combination of authorship is sufficient indication of the recognition of the close intimacy which exists between geography and geology. The three parts now issued are generally geographical in their purpose; a fourth which is to follow is more strictly geological.

Part i. deals with the subject of Asiatic peaks, and is an admirable summary of existing knowledge about them. We have a most interesting series of notes on their altitude, constitution, names, distribution, and geology. "The determination of their position and heights is the first step on the ladder of geographical knowledge," says Col. Burrard, and the fundamental part which they play in the making of maps and in the evolution of a scientific conception of the configuration of mountain systems is well illustrated. In spite of the increase of local knowledge which must be the result of closer and more intimate exploration, every geographer will agree with Col. Burrard's appeal for the retention of well-known names with no unnecessary and pedantic changes of spelling, or constant correction of altitudes, in our maps. As regards the altitudes, however, it might be well to consider whether the figures finally adopted might not be reduced to round numbers. All the difficulties attending the determination of great altitudes are touched upon by Col. Burrard, and when we consider the errors which may arise from a wrong estimation of corrections due to refraction; from local deflection of the level; from the varying depths of snow overlying the peak; or even from that elusive quantity, mean sea-level; we may fairly ask whether we are justified in crystallising the height of Mount Everest, for instance, at 29,003 feet instead of rendering it in terms (so much easier to remember) of 29,000. K_2 at 28,250 is satisfactory, but Kinchinjunga at 28,146 would surely be better at 28,150. A strict adherence to the mean value deduced from all observations taken is no doubt necessary as an official record, but its introduction into the ordinary map does certainly tend towards a false impression of minute accuracy.

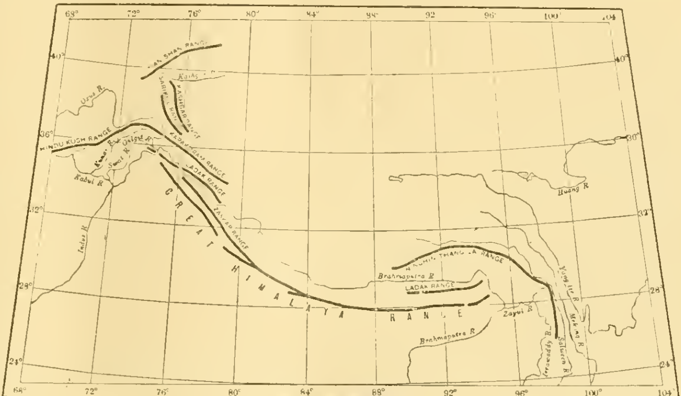

Chart to illustrate how the Great Himalaya range terminates first at the Indus, and secondly at the Brahmaputra.

Part ii. deals with mountain ranges and their conformation, and in this part we think that the geographical element has been too much subordinated to geology. Col. Burrard's theories of the original formation of the gigantic uplands and hills of Asia is beyond criticism. They have long been accepted as the fundamental explanation of mountain structure, and we welcome with thankfulness a plain and simple statement of those general principles which govern the relationship between water partings and ranges; by which mountain folds have been arranged in orderly lines, determining the main features of any great system—only to be cut to pieces and re-shaped into what appears to be haphazard irregularity by denudation and river action. But the geographer can hardly treat these latter phases of mountain construction with such scant respect as the geologist. Like the map-maker, who first defines all his river courses and then fills in the mountains between, he maintains that it is the river and valley which is of paramount economic importance; and if two rivers between them carve out a range in a direction absolutely transverse to the original tectonic folds, that such a range for all practical purposes may be vastly more important than the battered, undermined, and disintegrated granite core which formed the axis of the primeval fold, but which is now only to be recognised by the magnificence of its detached (but duly aligned) groups of gigantic peaks. To put it shortly, Col. Burrard maintains that inasmuch as the groups of highest peaks which follow an orderly curve through the length of the Himalaya indicate the main range of the system, this fact should be emphasised in topographical maps rather than main water partings or river systems. Scientifically, doubtless, this may be correct, but the travelling public for whom maps are made will, we fear, still fail to see with the eye of scientific faith, and will continue to believe the outward and visible evidence that these peaks are on spurs emanating from a main water-parting.

There is also great difficulty in determining the exact position of some of these great structural folds. Col. Burrard has apparently encountered this difficulty, for the letterpress at p. 123, part iii. (dealing with river systems), hardly tallies with Fig. 2 of chart xxi. in part ii. Assuming that Col. Burrard includes the Ghorband drainage with that of the Panjshir in the former (which we must do), the southern ridge, or fold, of the Hindu Kush trough gets mixed up with the continuation of the "Kailas" fold as depicted in the latter. Nor can we accept the statement as altogether proven that the Hari Rud valley represents a primeval tectonic trough and not the result of subsequent erosion. Col. Talbot (who surveyed the valley) believed it to be the latter, and there is certainly no trace of a crystalline core to the ranges north and south of the Hari Rud. It is not altogether out of place to note that the assumption of a double range for the Hindu Kush may lead to serious political complications. If this double range exists, what becomes of our boundary (at present

undemarcated except by nature) with Afghanistan? It is defined by the main water parting of the Hindu Kush. Which is to be the main water parting?

One more small criticism must be permitted ere we close a sketchy notice of a work so valuable as to require serious and well-considered analysis. The use of a publication of this sort to the ordinary traveller is largely limited by its portability. In its present form it would hardly serve the purpose of the mountaineer, who must before all things consider size, weight, and general handiness; and yet it is specially written for the mountaineer. Most of the illustrations (which probably govern the size of the issue) could be reduced to one-quarter their present size, and the rest could be folded in a separate pocket. It is much to be hoped that this treatise will have a wide circulation, but there is too much of the regular official "Survey of India" type of publication about it for general use in its present form. T. H. H.

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held as usual on St. Andrew's Day, November 30, at Burlington House. The report of the council was presented, in which reference was made to the chief subjects to which attention had been given during the year. As Lord Rayleigh expressed the desire to resign the presidency, the council submitted the name of Sir Archibald Geikie, K.C.B., for election into the office of president. To fill the vacancy thus created it was proposed to transfer the foreign secretary, Prof. J. R. Bradford, into the office of principal secretary, and to elect Sir William Crookes as foreign secretary. The officers, and also the other members of the council whose names were given in NATURE of November 5 (p. 15), were elected at the annual meeting. Among other matters mentioned in the report of the council of the Society we notice the following:

Two volumes have been issued descriptive of the physical work of the National Antarctic Expedition. During the expedition a large number of photographs were taken of the scenery and physical features, partly also of the biology of the regions visited, while Mr. E. A. Wilson made many careful drawings of the various coast-lines that were passed. Although certain of these photographs have already been reproduced in some of the reports and other works descriptive of the expedition, it was decided to publish an ample and thoroughly illustrative series of both the photographs and the sketches, accompanied with maps which should show the precise position of each spot from which a panoramic photograph or sketch had been taken. Future explorers will thus be helped to note any changes which may affect the snow-fields, glaciers, ice-barriers, or other features, while the general public will be put in possession of a remarkably striking series of views of Antarctic scenery and life. Accordingly, an Antarctic album and portfolio have been prepared by Mr. Wilson under the supervision of the committee, and are now nearly ready for publication.

Within the last few weeks Dr. Mond has directed the attention of the officers of the society to the desirability of further acceleration of the catalogue of scientific papers. As the result of conferences with the officers and the director of the catalogue, he has undertaken to increase his previous generous subventions by a sum of 2000*l.* on condition that the society fall in with his suggestion that additional expert assistance be employed to deal with the arrangement of the material for the subject indexes, and an effort be thus made to finish the index volumes for mechanics, physics, and chemistry within two or three years.

In April a letter was received from the Home Office on the subject of the disease known as glass-workers' cataract, inquiring whether elucidation of the cause of the disease and its remedy, in the light of the physical and physiological problems involved, could be made the subject of an inquiry by a committee of the Royal Society. After full consideration the council appointed a committee to inquire into and report on this subject.

Changes have been made in the regulations as to grants for scientific investigations. In order that applicants may be informed earlier in the year of the decisions of the Government Grant Committee with regard to grants, the regulations now provide that applications shall be received not later than January 1, and it is therefore hoped that it may be possible for the general committee to meet at some time before the end of March instead of in May.

In 1870 the society placed in the hands of Sir William Huggins, on loan, an equatorial mounting and twin telescopes, purchased by means of the Oliveira bequest, which was to be expended on a telescope. As was announced in last week's NATURE (p. 114), Sir William Huggins is unable now to make such use of the instruments as would justify him in retaining them. A new home for the instruments has been found, therefore, at the University of Cambridge.

At the end of last year a letter was received from the Colonial Office asking the society to advise in detail as to means for carrying out the further researches recommended by the tropical diseases committee, as specified in the last report to the council. At the invitation of the committee Colonel Sir David Bruce has undertaken the supervision of further investigations in Uganda, and sailed in September last.

The scheme for the establishment of an International Central Bureau in connection with sleeping sickness, referred to in the last report, having fallen through, H.M. Government decided to establish a National Bureau in London, to be administered on similar lines, the cost being defrayed from Imperial funds, including a contribution from the Sudan. The bureau was definitely established in June last, one of the society's rooms being placed at its disposal at the request of the Colonial Office.

In his presidential address Lord Rayleigh referred to the heavy losses by death sustained by the Society among its fellows and foreign members. Particular reference was made to Lord Kelvin, Sir Richard Strachey, Dr. Sorby, and Sir John Evans as having passed away since the last anniversary meeting. These and other main subjects of the address are here summarised:—

We are fortunate in having secured for our Proceedings a review of Kelvin's life and work, written by one who is especially well qualified for the difficult task. I do not doubt that Prof. Larmor is right in placing in the forefront of that work those fundamental advances in thermodynamics which date from the middle of the last century. It was Kelvin who first grasped the full scope of the principle known as the second law, a law which may indeed well be considered to stand first in order of importance, regarded from the point of view of man's needs and opportunities.

My acquaintance with Kelvin was limited, until about 1880, a time when I was occupied with measurements relating to the electrical units, and received much appreciated encouragement. From then onwards until his death I enjoyed the privilege of intimacy and, needless to say, profited continually from his conversation, as I had done before from his writings.

Dr. Sorby belonged to a class on whom England has special reason to congratulate herself, men who pursue science unprofessionally. The names of Cavendish, Young, Joule, and Darwin at once suggest themselves. It is to be feared that specialisation and the increasing cost and complication of experimental appliances are having a prejudicial effect in this regard. On the other hand, the amateur is not without advantages which compensate to some extent. Certainly, no one who has the root of the matter in him should be deterred by fears of such difficulties, and the example of Sorby suffices to show how much is open to ingenuity unaided by elaborate appliances.

On the foreign list also the losses are heavy. We have especially to condole with our colleagues in France upon the havoc caused by death within the last year or two. Janssen and Mascart, who was much missed at the recent

Electrical Conference, had reached a full age; but Becquerel was in the full tide of life, and we had hoped to learn much more from him. As the discoverer of radio-activity, he had opened up inquiries the significance of which seems ever on the increase. Science has lost a leader; his friends and the world a charming personality.

During the time that I was secretary, and so concerned with the passing of mathematical papers through the press, I was much struck with the carelessness of authors in the arrangement of their manuscript. It is frequently forgotten that a line of print in the Transactions and in the new form of the Proceedings will hold much more than a line of ordinary manuscript, unless, indeed, the handwriting is exceptionally small. Unless the authors' indications were supplemented, it frequently occurred that several lines of print were occupied by what might equally well, and in my judgment much better, be contained in one line. Even practised writers would do well, when they regard their manuscript as complete so far as regards matter and phrasing, to go over it again entirely from the point of view of the printing. In this way much expense and space would be spared, and the appearance of the printed page improved.

Apart from questions of printing, the choice of symbols for representing mathematical and physical quantities is of some importance, and is embarrassed by varying usages, especially in different countries. A committee now sitting is concerned with the selection of symbols for electrical and magnetic quantities, but the question is really much wider. One hesitates to suggest another international conference, and perhaps something could be done by discussion in scientific newspapers. Obviously some give and take would be necessary. When the arguments from convenience are about balanced, appeal might be made to the authority of distinguished men, especially of those who were pioneers in the definition and use of the quantity to be represented. As an example of the difficulties to be faced, I may instance the important case of a symbol for refractive index. In English writings the symbol is usually μ, and on the Continent n. By the early optical writers it would seem that no particular symbol was appropriated. In 1815 (Phil. Trans., 1815) Brewster has m. The earliest use of μ that I have come across is by Sir John Herschel (Phil. Trans., 1821, p. 230), and the same symbol was used by Coddington (1829) and by Hamilton (1830), both distinguished workers in optics. On the other hand, n was employed by Fraunhofer (1815), and his authority must be reckoned very high. As regards convenience, I should suppose that the balance of advantage would incline to μ, since n is wanted so frequently in other senses. Another case in which there may be difficulties in obtaining a much-to-be-desired uniformity is the symbol for electrical resistance.

On a former occasion I indulged in comment upon the tendency of some recent mathematics, which were doubtless understood as the mild grumbling of an elderly man who does not like to see himself left too far behind. In the same spirit I am inclined to complain of what seem unnecessary changes in mathematical nomenclature. In my youth, by a natural extension of a long-established usage relative to equations, we spoke of the *roots* of a function, meaning thereby those values of the argument which cause the *function* to vanish. In many modern writings I read of the *zeroes* of a function in the same sense. There may be reasons for this change; but the new expression seems to need precaution in its use, otherwise we are led to such flowers of speech as "zeroes with real part positive," which I recently came across (Proc. Math. Soc., vol. xxxi., p. 266). But though I may use a little my privilege of grumbling over details, I hope I shall not be misunderstood as undervaluing the progress made in recent years, which, indeed, seems to me to be very remarkable and satisfactory, regarded from the scientific point of view. On the other hand, I cannot help feeling misgivings as to the suitability of the highly specialised mathematics of the present day for a general intellectual training, and I hope that a careful watch may be maintained to check, in good time, any evil tendencies that may become apparent.

Among the notable advances of the present year is the liquefaction of helium by Prof. Onnes, of Leyden. It is but a few years since Sir J. Dewar opened up a new field of temperature by his liquefaction of hydrogen, and now a further extension is made which, if reckoned merely in difference of temperature, may appear inconsiderable, but seen from the proper thermodynamical standpoint is recognised to be far-reaching. The exploration of this new field can hardly fail to afford valuable guidance for our ideas concerning the general properties and constitution of matter. Prof. Onnes's success is the reward of labours well directed and protracted over many years.

The discovery and application by Rutherford and Geiger of an electrical method of counting the number of α particles from radio-active substances constitutes an important step, and one that appears to afford better determinations than hitherto of various fundamental quantities. It would be of interest to learn what interpretation is put upon these results by those who still desire to regard matter as homogeneous.

Another very interesting observation published during the year is that of Hale upon the Zeeman effect in sun-spots, tending to show that the spots are fields of intense magnetic force. Anything which promises a clue as to the nature of these mysterious peculiarities of the solar surface is especially welcome. Until we understand better than we do these solar processes, on which our very existence depends, we may do well to cultivate a humbler frame of mind than that indulged in by some of our colleagues.

A theoretical question of importance is raised by the observations of Nordmann and Tikhoff showing a small chromatic displacement of the phase of minimum brightness in the case of certain variable stars. The absence of such an effect has been hitherto the principal argument on the experimental side for assuming a velocity of propagation in vacuum independent of frequency or wave-length. The tendency of the observations would be to suggest a dispersion in the same direction as in ordinary matter, but of almost infinitesimal amount, in view of the immense distances over which the propagation takes place. Lebedew has pointed out that this conclusion may be evaded by assuming an asymmetry involving colour in the process by which the variability is brought about, and he remarks that although the dispersions indicated by Nordmann and Tikhoff are in the same direction, the amounts calculated from the best available values of the parallaxes differ in the ratio of 30 to 1. In view of this discrepancy and of the extreme minuteness of the dispersion that would be indicated, the probabilities seem at the moment to lie on the side of Lebedew's explanation; doubtless further facts will be available in the near future.

I cannot abstain from including in the achievements of the year the remarkable successes in mechanical flight attained by the brothers Wright, although the interest is rather social and practical than purely scientific. For many years, in fact ever since I became acquainted with the work of Penaud and Wenham, I have leaned to the opinion that flight was possible as a *feat*. This question is now settled, and the tendency may perhaps be to jump too quickly to the conclusion that what can be done as a feat will soon be possible for the purposes of daily life. But there is a very large gap to be bridged over; and the argument urged by Prof. Newcomb, and based on the principle of dynamical similarity, that the difficulties must increase with the scale of the machines, goes far to preclude the idea that regular ocean service will be conducted by flying machines rather than by ships; but, as the history of science and invention abundantly proves, it is rash to set limits. For special purposes, such as exploration, we may expect to see flying machines in use before many years have passed.

The report of the National Physical Laboratory for the year again indicates remarkable growth. The various new buildings, which have been erected and equipped during recent years at a cost of about 33,000*l*., are now occupied, and the result is that both researches and test work can be carried out with much greater ease and efficiency than previously. The buildings of the magnetic observatory at Eskdalemuir are now occupied, but, unfortunately, difficulty has arisen in making the magnetograph rooms, which are underground, completely water-tight, and the recording apparatus is not yet properly installed.

The progress of the "Royal Society Catalogue of Scien-

tific Papers" has advanced a definite stage during the year through the publication, by the Cambridge University Press, of the index volume of pure mathematics for the nineteenth century. Owing to the magnitude of the material to be indexed in the several sciences, it has been necessary to adopt drastic measures of compression, and the 40,000 entries involved in the present section have thus been condensed into one royal octavo volume of some 700 pages.

Through the kindness of Dr. Schuster I had the opportunity of submitting to the council, before the expiry of my term of office, a generous proposal which he makes for instituting a fund of 1500*l.*, the interest of which is to be applied to pay the travelling expenses of delegates of the society to the International Association of Academies. Dr. Schuster felt that the absence of such a provision laid a burden upon delegates, and might operate to limit the choice of the society. I was empowered by the council to convey their cordial thanks to Dr. Schuster, and I have now the pleasure of making his benefaction known to the society at large.

MEDALLISTS, 1908.

COPLEY MEDAL.

The Copley medal is awarded to Dr. Alfred Russel Wallace, F.R.S.

It is now sixty years since this distinguished naturalist began his scientific career. During this long period he has been unceasingly active in the prosecution of natural-history studies. So far back as 1848 he accompanied the late Henry Walter Bates to the region of the Amazon, and remained four years there, greatly enriching zoology and botany, and laying at the same time the basis of that wide range of biological acquirement by which all his writings have been characterised. From South America he passed to the Malay Archipelago, and spent there some eight fruitful years. It was during his stay in that region that he matured those broad views regarding the geographical distribution of plants and animals which on his return to this country he was able to elaborate in his well-known classic volumes on that subject. It was there, too, amid the problems presented by the infinite variety of tropical life, that he independently conceived the idea of the theory of the origin of species by natural selection which Charles Darwin had already been working out for years before. His claims to the admiration of all men of science were recognised by the Royal Society forty years ago, when, in 1868, a Royal medal was awarded to him. Again, when in 1890 the Darwin medal was founded, he was chosen as its first recipient.

RUMFORD MEDAL.

The Rumford medal is awarded to Prof. Hendrik Antoon Lorentz, For.Mem.R.S.

Prof. Hendrik Antoon Lorentz, of Leyden, has been distinguished during the last quarter of a century by his fundamental investigations in the principles of the theory of radiation, especially in its electric aspect. His earliest memoirs were concerned with the molecular equivalents which obtain in the refractive (and dispersive) powers of different substances; in them he arrived at formulæ that still remain the accepted mode of theoretical formulation of these phenomena. The main result, that

$$(\mu^2-1)/(\mu^2+2)$$

is proportional jointly to the density of distribution of the molecules, and to a function of the molecular free periods and the period of the radiation in question, rests essentially only on the idea of propagation in some type of elastic medium; and thus it was reached simultaneously, along different special lines, by H. A. Lorentz originally from Helmholtz's form of Maxwell's electric theory, and by L. Lorenz, of Copenhagen, from a general idea of propagation after the manner of elastic solids.

The other advance in physical science with which Prof. Lorentz's name is most closely associated is one of greater precision, the molecular development of Maxwell's theory of electrodynamics.

ROYAL MEDALS.

A Royal medal is awarded to Prof. John Milne, F.R.S., for his work on seismology. In 1875 Dr. Milne accepted the position of professor at Tokyo, which was offered to him by the Imperial Government of Japan. His attention was almost immediately attracted to the study of earthquakes, and he was led to design new forms of construction for buildings and engineering structures with the view of resisting the destructive effects of shocks. His suggestions have been largely adopted, and his designs have been very successful for the end in view. Incidentally, he studied the vibrations of locomotives, and showed how to obtain a more exact balancing of the moving parts, and thus to secure smoother running and a saving of fuel. Here again his suggestions were accepted, and his work was recognised by the Institution of Civil Engineers.

He next devoted himself to the study of artificial shocks produced by the explosion of dynamite in borings. He then studied actual shocks as observed at nine stations connected by telegraph wires. A seismic study of Tokyo, and subsequently of the whole of northern Japan, followed. In this latter work he relied on reports from fifty stations. The Government then took up the matter, increased his fifty stations to nearly 1000, and founded a chair of seismology for Mr. Milne. On his return to England in 1895 he succeeded in obtaining international cooperation, and reports are now received by him from some 200 stations furnished with trustworthy instruments, and scattered all over the world.

The work of Dr. Henry Head, on which is founded the award of the other Royal medal, forms a connected series of researches on the nervous system (made partly in conjunction with Campbell, Rivers, Sherren, and Thompson), published for the most part in *Brain* at various times since 1893 up to the present date, and constituting one of the most original and important contributions to neurological science of recent times.

His first paper ("Disturbances of Sensation with Special Reference to the Pain of Visceral Disease," 1893), founded on minute and laborious clinical investigation, established in a more precise manner than had hitherto been done the relations between the somatic and visceral systems of nerves. He confirmed from the clinical side the experimental researches of Sherrington on the distribution of the posterior roots of the spinal nerves.

DAVY MEDAL.

The Davy medal is awarded to Prof. William Augustus Tilden, F.R.S.

The researches of Prof. Tilden extend into many domains. His recent work on the specific heats of the elements in relation to their atomic weights, described to the society in the Bakerian lecture for 1900, and in two later papers published also in the Philosophical Transactions, is of high theoretical importance. The employment of liquid oxygen as an ordinary laboratory reagent, rendered possible by the researches of Dewar and others, has enabled Prof. Tilden to test the validity of Dulong and Petit's law and of Neumann's law over a much wider range of temperature than was possible before, and to give a truer estimate of the range of their validity.

In the region of organic chemistry he has carried out important researches on the terpenes, such as that on the hydrocarbons from *Pinus sylvestris*, on terpin and terpinol, and on limettin. In inorganic chemistry, his investigations on *aqua regia* and on nitrosyl chloride are especially noteworthy.

DARWIN MEDAL.

The Darwin medal is awarded to Prof. August Weismann for his contributions to the study of evolution. He was one of the early supporters of the doctrine of evolution by means of natural selection, and wrote in support of the Darwinian theory in 1868. His great series of publications from that date onward must always remain a monument of patient inquiry. In forming an estimate of his work, it does not seem essential that we should decide on the admissibility of his germ-plasm theory. It is in like manner unimportant that he was, in certain respects, forestalled by Galton, and that his own views have undergone changes. The fact remains that he has

done more than any other man to focus scientific attention on the mechanism of inheritance.

HUGHES MEDAL.

The Hughes medal is awarded to Prof. Eugen Goldstein. Prof. Goldstein was one of the early workers on the modern detailed investigation of the electric discharge in rarefied gases, and by long-continued researches has contributed substantially to the systematic analysis of the complex actions presenting themselves in that field. Of these researches may be mentioned his observations of the effect of magnetic force on striations, of the phosphorescence produced by the kathode rays, and of the reflection of kathode rays.

By his discovery of the so-called Kanalstrahlen, or positive rays, he has detected an essential feature of the phenomenon, which, in his own hands and in those of other workers, has already thrown much needed light on the atomic transformations that are involved.

THE PAST AND PRESENT OF THE ROYAL SOCIETY.

At the anniversary dinner, held at the Hôtel Métropole on Monday evening, Sir Archibald Geikie presided, and a distinguished company of fellows and their guests assembled together.

Prof. Lorentz, in proposing the toast of "The Royal Society," said he availed himself of the opportunity for saying a few words about the Royal Society, the time-honoured and world-renowned institution which for two centuries and a half had pursued with untiring energy the object for which it was founded—the improvement of natural knowledge. Surely there were few things so wonderful as that society, originating in a small club of persons who met weekly in the most simple manner for the discussion of philosophical inquiries, and grown by its own force, unaided by the State, as other academies usually were, to a mighty body which extended its influence all over the globe, and the annals of which showed a long list of the very first and most illustrious of natural philosophers, from Boyle and Newton to Charles Darwin and Lord Kelvin. The most striking feature in their long history was, perhaps, the unbroken continuity between the past and the present, between the modest beginnings and the glorious onward career, a continuity that was perspicuous, not only in the constancy of their true and high scientific spirit, but also, he thought, in the outward form. The collected works of Huygens, now being published, contained about 3000 letters, and many of them were directed to or received from members of their society, the chief correspondents at the time of which he was now speaking being Moray, the first secretary, Oldenburg, and eventually their first president, Lord Brouncker. Among the subjects treated in these letters there were some very proper for illustrating the continuity of which he had spoken. For instance, Lord Brouncker devoted much of his time to pendulum experiments for the purpose of finding a universal and natural unit of length. He was careful about the material of which the pendulum should be made. It ought, he thought, to be of good silver. In these days they had seen Sir J. J. Thomson experimenting with a pendulum which consisted of much more valuable material, namely, radium, though not, of course, made entirely of radium. So in those early days they could notice a feature that seemed to him to be characteristic of British physical science, the invention of mechanical models for the purpose of illustrating natural phenomena, a method that had borne such splendid fruits in the hands of Faraday, Lord Kelvin, Maxwell, and their successors.

In responding to the toast of "The Royal Society," the newly elected president, Sir Archibald Geikie, spoke as follows:—

It is not without interest on an occasion like the present to look back for a little at the first beginnings of such an institution as the Royal Society, and to compare and contrast its present condition with that of its infancy. In the middle of the seventeenth century, amidst the first impetus given by the writings of Francis Bacon, a small company of enthusiasts for what was called the "New Philosophy," including such men as Robert Boyle, Robert Hooke, William Petty, John Evelyn, and Henry Oldenburg, met together in London, mainly for the purpose of making experiments and discussing with each other the lessons to be drawn therefrom. This select company, which some of its members knew by the name of "The Invisible College," eventually gained the sympathetic notice of Charles II. He incorporated and named them "The Royal Society," and such was his interest in their welfare that he was induced to grant them no less than three charters in the course of seven years. He is said to have suggested to them various subjects for experiment, but there is good evidence that, with his keen sense of humour, he liked sometimes to make fun of them. Pepys tells how, a few months after the society had received its first charter, the King "mightily laughed at them for spending time in weighing of ayre and doing nothing else since they sat." The Royal example was followed with less good nature by poets such as Butler, who satirised the young society; but the philosophers outlived the sarcasm. That they were in most serious earnest in their experimental inquiries was shown by their appointing and subsidising some of their number as "curators of experiments," whose duty it was to prepare experiments which were exhibited and discussed at their weekly meetings. These experimental demonstrations and the discussions arising from them, rather than the reading of set papers, were the characteristic feature of the earliest meetings of the society.

In those days the range of natural knowledge was comparatively limited, so that a fairly complete acquaintance with all its fields was not beyond the compass of any man of average intelligence and industry; but as this range widened and the boundaries of the several branches of science extended, it became in the course of years increasingly difficult to follow the original experimental arrangements for the meetings. Fully equipped laboratories had to be created outside the Royal Society, where long and intricate series of connected experiments and investigations could be carried on in the domains of physics and chemistry, and ultimately also of biology. Hence by degrees papers descriptive of these researches supplanted at the society's meetings the older practical demonstrations of the processes of experiment, and came to be, as they are now, the recognised form in which advances in science are laid before the society.

The reading of these papers, or abstracts of them, the careful consideration of them by specially appointed committees, and the ultimate publication of such of them as are approved in the Proceedings or Philosophical Transactions, form the main part of the scientific work of the Royal Society at the present time. We can point with not unjustifiable pride to our long series of published volumes as a memorable record of the advance of all branches of natural science during nearly 250 years, and of the share which the society has had in furthering this progress.

But the meetings, discussions, and publications form only a portion of the ordinary business of the Royal Society. I think it is not generally known how much additional work the society is now called upon to undertake. The confidence felt by Parliament, the Government, and the country at large in the society's capacity and judgment is shown by the multifarious tasks which have been entrusted to it, outside of what might well be regarded as its more legitimate sphere of operations. Thus it nominates a representative to the governing body of each of the great public schools, who is specially charged to watch over the interests of science in the general curriculum of instruction. It has a voice in the election of some of the scientific chairs in the two older universities. It administers the annual Parliamentary grant of 4000*l.* for the furtherance of scientific investigations. It has been entrusted with the control and supervision of the National Physical Laboratory. It takes a large share in the visitation and direction of Greenwich Observatory. It nominates nearly one-half of the Lawes trust, which has rendered such important services to the scientific development of agriculture.

Over and above these standing engagements, if one may so call them, the Royal Society is not infrequently consulted by the various public departments of the country in regard to questions wherein expert scientific knowledge

is required. In recent years these applications have had more special reference to the nature and origin of various diseases in our colonies and stations abroad, and the best means to be adopted for coping with them. As an illustration of this side of the society's activity, I may refer to our late inquiry into Malta fever—a disease which for many years so seriously disabled our naval and military establishments in the Mediterranean basin. This investigation was undertaken at the joint request of the Admiralty, War Office, and Colonial Office. Within a few months we were fortunate in discovering the source of the malady, and were able to point out the precautions to be taken in dealing with the fever. The satisfactory result has been attained of almost entirely banishing the disease from the hospitals of Malta. A more difficult and prolonged inquiry has been in progress for some years into the terrible evil of sleeping sickness. The commission sent out to Central Africa by the Royal Society soon ascertained the immediate cause of the malady, but although the investigation has been prosecuted in various directions, no certain cure or preventive has yet been found. A few weeks ago our eminent and intrepid colleague Sir David Bruce, taking with him two officers of the Army Medical Department, returned to Uganda to renew his inquiries on the spot. We have also a committee at work in London endeavouring to discover a drug that may be effectual in the treatment of trypanosome diseases. We sincerely hope that the various efforts now in vigorous operation may be ultimately successful, and thus that in wide tracts of Central Africa which have been so grievously depopulated, this fatal scourge, if not wholly exterminated, may at least be reduced alike in its area of distribution and in the seriousness of its effects. I may add that the Colonial Office recently established a national bureau for the purpose of collecting and disseminating information from all quarters regarding sleeping sickness, and that the Royal Society, at the request of that public department, has been glad to provide for the bureau such office accommodation as the limited space at Burlington House will permit.

Ever since the year 1662 the Royal Society has met on St. Andrew's Day for the purpose of electing its council and officers. This important annual function has been discharged this afternoon, with the result which is before you. The whole body of fellows must sincerely regret that our recent president, Lord Rayleigh, felt himself unable to serve the full period of his tenure of the office. We are all grateful to him for the care and attention which he constantly gave to the business, alike at the meetings of council and at those of the society, over which he presided with unfailing tact and dignity. We trust that he will return from South Africa re-invigorated for the resumption of those studies which, while placing him in the first rank of leaders in science, have reflected so much lustre on the Royal Society. The vacancy in the secretaryship has been filled by the election of Prof. Rose Bradford. Having already served for one year as foreign secretary, he has gained experience in the details of the business of the society, and he assumes his new duties with the heartiest good wishes of his brother-officers and, I am confident, also of the general body of the fellows. In our new foreign secretary, Sir William Crookes, we have a man of world-wide fame, whose election will be hailed abroad with not less approbation than it has received at home.

There was once a time when the Royal Society, so long accustomed to reign alone among the scientific institutions of the country, was disposed to look askance upon the rise of other learned societies the main object of which was the cultivation of some single department of science. Happily that time has long since passed. The most cordial relations now bind the younger offspring to their venerable mother. These special societies, which have so multiplied in our own time, have been of enormous service in advancing the progress of their several departments of inquiry. Science has grown far beyond limits that can be adequately supervised by any single organisation. Almost all the Fellows of the Royal Society belong also to one or more of these societies; but no practical inconvenience arises from any divided allegiance. While chemists, geologists, zoologists, or botanists are loyal members of their several special societies, they are happy to be included also in the ranks of the Royal Society. They are proud of its prestige, of its traditions, of the large part it has played in the history of British science, and of the high position which it holds among the academies of the world. They recognise its catholicity alike in the selection of its fellows and in the papers which it prints in its publications. They see that while other learned bodies properly concern themselves with their own special fields in the scientific domain, the Royal Society, true to the spirit of its earliest leaders, continues to welcome any worthy addition to any department of natural knowledge, not from its own fellows only, but from outside workers who are found to have something new and of real value to communicate.

In four years hence the Royal Society will complete its fifth half-century. Nevertheless, though old in years, it remains still young in energy and aspiration. With the cooperation of the other societies we look forward to a future not less distinguished and useful than our past has been.

Speeches were also made by Prof. Tilden, Dr. Head, Lord Avebury, the Italian Ambassador, and the Bishop of London.

NOTES.

THE account which we print elsewhere of the anniversary meeting and dinner of the Royal Society contains many interesting statements of work accomplished and undertaken. Of particular interest is the election of Sir Archibald Geikie as president of the society in succession to Lord Rayleigh, who is leaving England for a long visit to South Africa, and has resigned the office held by him with such distinction for the past three years. In nominating Sir Archibald Geikie to the presidency, the council complied with a desire widely expressed in the society, and his election on Monday has given satisfaction, not only to fellows of the society, but also to the wider circle of workers in many departments of intellectual activity who admire his genius both on the scientific and literary sides. As Prof. de Lapparent pointed out in an article upon Sir Archibald Geikie's work contributed to our "Scientific Worthies" series in January, 1893:—"Since nothing in the world is less common than the union of scientific insight and acuteness with a vivid appreciation of nature and a delicate feeling for style, it is not strange that Sir Archibald's fame has passed far beyond the circle of professional men." The article showed that the claims of Sir Archibald Geikie to the highest form of recognition in the scientific world are of outstanding importance. Of all British geologists he has long been acknowledged as the most distinguished, and his election to the presidential chair of the Royal Society has given universal satisfaction.

WE regret to learn that M. Albert Gaudry, foreign member of the Royal Society, died on Sunday, November 29.

WE notice with regret the announcement that Dr. E. T. Hamy, professor of anthropology at the Paris Museum of Natural History and member of the Academy of Medicine, died on November 18, in his sixty-sixth year.

THE death is announced of Dr. O. T. Mason, head curator of the department of anthropology of the U.S. National Museum.

IT is announced that the Nobel prize for physics has been awarded to Prof. M. Planck, professor of mathematical physics in the University of Berlin; and the prize for chemistry to Prof. E. Rutherford, F.R.S., Langworthy professor of physics in the University of Manchester.

PROF. R. ABEGG, of Breslau, informs us that the award of 2500 marks made to him by the Berlin Academy of Sciences was not a prize, as announced in NATURE of November 26 (p. 104), but a grant to enable him to purchase the gallium required for the physicochemical studies which he has undertaken of that substance.

THE death is reported, after a long illness, of Dr. William Keith Brooks, professor of zoology at the Johns Hopkins University, Baltimore. He was born at Cleveland, Ohio, in 1848, and had been a member of the staff of Johns Hopkins since its foundation in 1876. He was the author of "A Handbook of Invertebrate Zoology," "The Stomatopoda of H.M.S. *Challenger*," "The Foundations of Zoology," "The Oyster," and "The Report of the Maryland Oyster Commission." He was popularly known as "the father of the oyster culture." He was a member of the National Academy of Sciences and of the American Philosophical Society.

THE gold medal awarded under the Shaw Trust for Industrial Hygiene was presented to Prof. Galloway, at the Royal Society of Arts, on November 18, "In recognition of his valuable researches into the action of coal dust in colliery explosions, the outcome of which researches has been the provision of means by which the risk of such accident is materially diminished, and a consequent great saving of human life effected."

PROF. BEYERINCK, of Delft, writes to point out that the spectra of planets illustrated by Prof. P. Lowell in NATURE of November 12, p. 42, resemble the absorption spectra of chlorophyll and accompanying pigments of different plants. For instance, "The spectra of Uranus and Neptune coincide with a spectrum produced by a chlorophyll solution containing much anthocyan, or perhaps still more with the absorption spectrum of a living Porphyra."

THE annual exhibition of apparatus is to be held by the Physical Society on Friday evening, December 11 (from 7 p.m. to 10 p.m.), at the Royal College of Science, South Kensington. From the programme, of which we have received an advance proof, there appear to be many items of considerable interest to both physicists and electrical engineers. We understand that invitations have been given to the Institution of Electrical Engineers, the Faraday Society, the Optical Society, and the Röntgen Society. Admission, however, except to Fellows of the Physical Society, will be by ticket only, and therefore members of the societies just mentioned desiring to attend the exhibition should apply to the secretary of the society to which they belong.

FOR nearly a year Lieutenant E. H. Shackleton, R.N.R., and his party of explorers have been engaged in exploration in South Polar regions. The explorers were taken to their landing-place in the Far South by the *Nimrod*, which then returned to Lyttelton. Despatches from New Zealand now state that the vessel has just left again for King Edward VII. land to take on board the explorers. It is anticipated that the *Nimrod* will reach the landing-place in about six weeks. Lieutenant Shackleton and his party will, it is hoped, put in an appearance before the end of February next, after which the *Nimrod* will make her way back to Lyttelton.

WE learn from the *Times* that the Admiralty will restore Halley's grave in the old burial-ground of Lee Parish Church. Dr. E. Halley, who was the Astronomer Royal from 1721 to 1742, was given the temporary rank of a captain in the Navy, and commanded a ship of war in 1698–1701, for the purpose of making observations for magnetic variations. With Sir Isaac Newton, he was responsible for the Act of 1714 offering a reward to any person who should devise a method for the discovery of the longitude at sea. His grave was last restored by the Admiralty in 1854.

THE Academy of Natural Sciences of Philadelphia has decided to confer the Hayden memorial medal for 1908 on Mr. J. M. Clarke, State Geologist of New York, in recognition of his distinguished services to geological science. The medal is a memorial which Mrs. E. W. Hayden endowed in honour of her husband, Dr. Ferdinand V. Hayden, who was for several years director of the Geological and Geographical Surveys of the territories, remaining one of the four principal geologists to the United States Geological Survey from its organisation in 1879 until his death. Provision was at first made to confer a bronze medal and the remainder of the interest of the fund annually as a recognition of the best publication, exploration, discovery, or research in the sciences of geology or palæontology. The bronze medal was awarded annually until 1899, when the deed was modified so as to provide for the awarding of a gold medal once every three years.

A BILL for putting in force the decisions of the Berlin Wireless Telegraphy Conference of November, 1906, as embodied in an international convention, has been laid before the French Chamber. The Paris correspondent of the *Times* gives the following details of the convention:—The conference has fixed wave-lengths, one of 300 metres, the other of 600 metres, for the transmission of public messages by the wireless current. All stations must be able to produce and to receive one, at all events, of these two wave-lengths. All public correspondence must be restricted to one of these wave-lengths. A coast station, however, can use other wave-lengths for long-distance communications, or for messages other than those transmitted by the public, provided that these wave-lengths are not under 600 metres and are not more than 1600 metres. Stations on board ship must use the 300-metre wave-length. They are permitted, however, to use other wave-lengths as well, provided that these are under 600 metres. Ships of small tonnage will be allowed to use a wave-length below 300 metres.

DURING the past week two important decisions have been announced in the British Courts of Appeal as to the definition of the term mineral. The question is of both scientific and commercial interest. When a railway buys land under compulsory powers, the minerals under the surface are reserved to the landowner, and have to be subsequently purchased by the railway company if at any time the proprietor is able to mine them. The railway companies are accordingly anxious to restrict the term mineral within narrow limits. The Court of Appeal, as announced in the *Times* of November 24, has unanimously confirmed the decision by Mr. Justice Eve in the case of the Great Western Railway Company against the Carpella Mining Company, that the china clay so extensively worked in Cornwall and Devonshire is a mineral. The Upper Court in Edinburgh, on the same day, re-affirmed the decision that in Scotland sandstone is a mineral, by dismissing an appeal by the North British Railway Company in reference to the working of sandstone beside the railway station at Shettleston.

THE appointment by the Government of a commission to register ancient monuments with the view of their better protection has been widely welcomed, but the

Government might do much to protect such remains by insisting that its own officials should treat them with consideration. One of the remarkable megalithic ruins of Malta appears to have just had a narrow escape, as in order to avoid the extra cost of a slight diversion of a new wall on the Corradino outside Valetta, one of the two most accessible of the archæological treasures of Malta was to have been ruthlessly swept away. Money for the wall was not available during the current year, so its erection was postponed, and we understand that in consequence of the protests by the Maltese archæologists and the intervention of the civil authorities the Admiralty officials have agreed that the wall shall be so diverted as to leave the megalithic remains uninjured. During the recent correspondence in the *Times* on the danger to the stone circles of Dartmoor, attention was directed to the destruction of a prehistoric stone group on land which had been sold to the War Office on the understanding that the antiquities should be preserved.

THE Royal Geographical Society has received from Dr. M. A. Stein an account of the final stage of his expedition into Central Asia. From an article in the *Times*, it appears that Dr. Stein started on August 1 last on his expedition to the sources of the Yurung-kash, or Khotan river. After making his way through the gorges of Polu to the northernmost high plateau, he turned to the west and succeeded in reaching the deep-cut valley of Zailik, which drains into the Yurung-kash. Terribly rugged as the valley of Zailik is, Dr. Stein ascended from it the high spurs coming down from the main Kwen-lun range northward, and by establishing survey stations was able to map the greater portion of the region containing the Yurung-kash headwaters. On the south the party proved to be flanked by a range of snowy peaks, rising to 23,000 feet, and clad with glaciers. By crossing side spurs over passes about 18,000 feet high, and ascending the gorge of the main river, they reached after eight marches from Zailik the glacier-bound basin in which the easternmost and largest branch of the river takes its rise. Having traced the river to its head, the party turned east to high ground on the Aksai-chin plateau. The object next accomplished was to reach the valley of the Kara-kash river. For this purpose the route which leads from Polu towards the Lanak-la pass and Ladak was followed. This took them to the uppermost valley of the Keriya river, and past the line of great glaciers which form its true sources. At last the watershed of the Keriya river was left behind, and the exploration of the hitherto unsurveyed ground westwards was commenced. The area before them, which in maps had figured as a high plain called Aksai-chin desert, proved soon of a different character. High snow-covered spurs with valleys between them were found to descend here from the range flanking the Yurung-kash. After a week they reached a large salt lake which an Indian survey party appears to have sighted more than forty years ago, but which has now become dry salt marsh. Continuing the journey to the north-west of it, they struck the traces of the old route by which Haji Habibullah, ruler of Khotan, had endeavoured to establish direct communication between Ladakh and his kingdom. Crossing several side spurs of the main range to the north, they emerged at last, on September 18, in the valley of the easternmost feeder of the Kara-kash.

THE weather summaries issued by the Meteorological Office show that for the autumn season, comprised by the thirteen weeks ended November 28, the mean temperature was largely in excess of the average over the entire area of the United Kingdom. The range of temperature was excessive, amounting to 60° and upwards in the east of Scotland, the east and south-west of England, and in the Midland counties. The aggregate rainfall was largely in defect, except in the east of Scotland and the south of Ireland, in both of which districts the excess was only a few hundredths of an inch. The deficiency was upwards of 3 inches in the south-east and south-west of England and in the Channel Islands. The duration of bright sunshine was in excess of the average in most of the English districts, the excess for the season amounting to seventy-five hours in the south-east of England, or 8 per cent. of the possible duration. The aggregate rainfall since the commencement of the year is in defect of the average over the entire kingdom, except in the north-west of England and the north of Ireland. In the Channel Islands the deficiency is 8·50 inches, in the south-west of England 6·14 inches, and upwards of 3 inches in the north-east and south-east of England. The excess of sunshine since the commencement of the year amounts to 151 hours, or 4 per cent. of the average duration in the south-east of England.

To Miss Georgina Sweet we are indebted for a copy of a paper, published in vol. xxi. of the Proceedings of the Royal Society of Victoria, on anatomical variation in the Australian tree-frog, *Hyla aurea*.

WE are indebted to Mr. A. E. Shipley for a separate copy of his account of the parasites infesting grouse, reprinted from the interim report of the Grouse Disease Commission, and likewise for one of a second paper, reproduced from the second number of *Parasitology*, on a threadworm infesting the swim-bladder of a trout.

IN their November issue, the editors of *British Birds* announce that they propose to institute further inquiries and investigations in regard to "wood-pigeon diphtheria," and for this purpose request the assistance of observers from all parts of the country, to whom schedules of queries will be supplied on application. Mr. C. B. Ticehurst will, as before, undertake the investigation. It is stated in the course of the notice that the supposed probability of this disease being communicable to man is not countenanced by Mr. Ticehurst.

A MUSEUM at Norwich, organised and maintained by Daniel Boulter, a dealer in curiosities in that city, during a part of the last quarter of the eighteenth century, forms the subject of an interesting paper (read at the Ipswich conference) by Mr. T. Southwell, published in the October number of the *Museums Journal*. To the same issue Dr. F. A. Bather contributes an account of the Lund Museum for the History of Culture, to the opening of which reference has been previously made in our columns.

IMPORTANT developments in regard to the administration of the Indian Museum, Calcutta, are foreshadowed in the report of the conference in regard to museums in India, held at Calcutta in December, 1907. There was a very representative attendance of Indian museum directors and curators (from Kashmir to Madras), and specialisation in the matter of administration was the order of the day. As regards the Indian Museum, it was decided that while the geological and palæontological section will remain, as heretofore, under the control of the director of the Geological Survey, the remaining collections will be placed under four distinct authorities. Archæology will be handed over to the director-general of archæology; the principal of the School of Art will assume control of the objects of industrial and fine art; the industrial collections will be transferred to the reporter on economic products; while

the anthropological and zoological collections are to be placed in charge of a superintendent directly responsible to the trustees. An alternative proposal to link up all the sections under the administrative control of a single director, who would likewise be inspector-general for museums in India, was decisively rejected.

WE have to acknowledge the receipt of copies of vol. xxx. of *Bericht des Westpreussischen Botanisch-zoologischen Vereins*, and of the *Schriften der Naturforschenden Gesellschaft in Danzig*, for 1908, the latter being now regarded as a supplement to the former. In the *Bericht* special interest attaches to an account, by Dr. P. Speoiser, of the distribution of the reindeer-gadfly (*Therioplectes tarandinus*) in the course of a paper on the fauna of the Barent district. The species ranges all over Siberia, northern Russia, and Scandinavia, but also occurs in a few isolated localities in north Germany, namely, in eastern Prussia near Königsberg, in western Prussia in the Tucheler Heide, as well as in Pomerania, Brandenburg, and Mecklenburg. There are also reports as to its occurrence in Austria and elsewhere. Its existence in these isolated localities may be taken as an indication that the insect has survived in such spots from the date when the reindeer inhabited a much larger area on the Continent than it does at present.

THE October number of the Journal of the Marine Biological Association (vol. viii., No. 3) contains the results of a series of experiments which have been recently conducted with regard to the food of mackerel and the movements of these fishes, with the view of assisting the western fishery. It appears that from April until June inclusive—the main fishery-time in the western districts—when mackerel collect in large shoals, they feed almost exclusively on plankton, and also that the plankton from the contents of the stomachs of the fish is identical with that taken in tow-nets in the neighbourhood of the shoals. During two years it was found that in April zooplankton was in excess of phytoplankton, and that during such times mackerel were more numerous than during the other months. Hence the abundance or paucity of zooplankton appears to be correlated with the greater or less abundance of fish, this being confirmed by the result of five years' experience. As regards the periodical migration of mackerel, it has been already suggested by previous authors that these are not so extensive as has commonly been supposed to be the case, and this is confirmed by the results of the recent observations. In accord with the observations of Cligny, it appears that mackerel return year after year at the close of the shoaling season to certain restricted areas not far distant from the spawning-grounds, and that at present only a few of these areas are known to fishermen. Further, these bottom-shoaling fish seem likewise to feed largely upon plankton. Additional observations are required before the bearing of these facts on the fishery can be fully realised.

BEARING in mind that some of the Central American species of Sapium may be found to yield latex containing a valuable percentage of rubber, Mr. H. Pittier has placed on record in the Contributions from the United States National Herbarium (vol. xii., part iv.) the identifications of nine species of the genus collected in Mexico and Central America. Of these, six species from Costa Rica are new to science. It is noted that proterandry is general, if not universal, so that the early flowers are staminate, while the latter are hermaphrodite, and it is doubtful whether any species of Sapium are ever diœcious.

THE superintendent of the botanic station at St. Vincent announces in his report for 1907–8 an increase in the export of cotton, and a slightly larger crop during the year, but ventures the opinion that the limit of production has been approached; if this be so, a yield of 175 tons represents the amount of Sea Island cotton that may be expected from the island. The output of cacao, that has increased annually since the effects of the hurricanes, now approximates to the amount of 100 tons. Among the trees that flowered in the gardens, mention is made of *Platymiscium platystachyum*, on account of the fragrance resembling violets diffused by the flowers.

A SUMMARY provided by Mr. G. Evans of the varieties of wheat grown in the Central Provinces of India and Berar has been published by the Department of Agriculture in that territory. In the northern divisions wheat occupies about one-third of the cropped area; in other parts cotton furnishes the chief staple. The varieties are classified under the four groups of hard and soft red and hard and soft white or yellow. A soft white variety is largely grown for export, as it produces a pure white flour; a hard yellow wheat from Nagpur is also exported, principally to southern Europe, for making macaroni and semolina. The author adopts five subspecies of *Triticum sativum*, under which he classifies the fifty varieties enumerated.

WE have received from the Bureau of Entomology of the United States Department of Agriculture a series of bulletins setting forth the beneficial results obtained by spraying with Bordeaux mixture and lead arsenate for codling moth and for the grape-root worm (*Fidia viticida*, Walsh). Another bulletin gives a brief description of the national collection of scale insects (Coccidæ), while others deal respectively with the apple-tree tent caterpillar (*Malacosoma americana*, Fab.), which can be controlled by arsenical washes, and the apple maggot (*Rhagoletis pomonella*, Walsh), which cannot.

ENGLISH students of American methods of agriculture will find much to interest them in a Bulletin (No. 12) recently issued by the Purdue University Agricultural Experiment Station, describing the methods of beef production adopted in Indiana. The information on which the bulletin is based was obtained by a method not uncommon in the States—a circular was sent round containing a full and carefully drawn up list of questions that farmers were requested to answer. The method has sundry disadvantages, but it enables a broad outline to be got out which will give the student all he needs.

AN interesting question in connection with the age of the prehistoric excavations made in search of flints at Brandon, in Suffolk, known as Grime's Graves, has now been set at rest by Mr. W. A. Sturge in the November number of *Man*. These pits were examined in 1870 by Canon Greenwell, who described the results in the Journal of the Ethnological Society (N.S., vol. ii., p. 419). Among the objects found and deposited in the British Museum is an axe of polished stone. In some recent discussions on the age of these excavations it has been urged that they date from pre-Neolithic times; but to establish these conclusions the evidence of Canon Greenwell's axe must in some way or other be got rid of. Hence an attempt has been made to throw doubt on the authenticity of this implement, and it has been suggested that it was surreptitiously introduced during the excavation by one of the workmen. Canon Greenwell fortunately retains a distinct recollection of the circumstances of the find, and gives a graphic account of the incident. Before it was discovered he had noticed markings on the chalk walls of

the pit which could not have been produced by the stag-horn picks usually employed by the workmen in prehistoric times. He guessed that they were the result of blows by a stone axe, the edge of which had become blunted and battered in a peculiar way by use. When the axe was subsequently found imbedded in the chalk, it was immediately recognised to be the identical tool with which these peculiar markings had been made. There can be no question, therefore, of the genuineness of the implement, or that the mutilation of the edge is contemporaneous with the period in which the tool was made and used. It thus supplies conclusive evidence that the pit was excavated during the period when polished stone implements were in use.

The annual report of the Transvaal Meteorological Department for the year ended June 30, 1907, shows that there is a considerable increase in the number of observers, all of which are volunteers or attached to other departments. The results of observations are arranged in appendices, as in previous reports; in many cases only means are printed, but the individual observations are available for any inquiry in case of need. In addition to the ordinary weather forecasts for the ensuing twenty-four hours, which are exhibited at every postal telegraph office, weekly forecasts have been prepared for the Agricultural Department when required; these are necessarily more indefinite than the daily forecasts. Investigations on various meteorological subjects are in such progress as the limited staff will permit; several papers have been communicated during the year to the *Meteorologische Zeitschrift* and other scientific periodicals. It may be mentioned that a new thermometer screen, constructed by Mr. D. E. Hutchins, with double laths instead of louvres, as in the Stevenson screen, has been under examination during a year. It costs less than the louvred screen, while the results obtained are practically the same.

The first number of a new scientific monthly, entitled *Ion, a Journal of Electronics, Atomistics, Ionology, Radioactivity, and Raumchemistry*, has just appeared. It is quarto in form, and contains eighty pages, well printed, with a fair number of diagrams, some of which have, however, been prepared from very rough drawings. About fifty pages are devoted to three articles on "The Charge carried by the α Particles," by Mr. F. Soddy; "Uranium and Geology," by Prof. Joly; and "Transmission of Energy in the World of Electrons," by Dr. H. W. Julius. Fifteen pages are devoted to reports on the various fields of work covered by the periodical, and three pages to reviews of ten books. Prof. Joly's paper is evidently an address, but no indication is given as to where it was delivered, and the reports would be increased in value if references to further sources of information were added. Several of the contributions require more careful editing, as they contain expressions which convey little meaning to a reader not well versed in German, but this may be due to the journal being printed in Germany. It would be a great convenience to its readers if it could be issued with the edges of the leaves cut. Notwithstanding these minor defects, which can be easily remedied in future numbers, *Ion* provides a physicochemical journal long needed in this country.

Until 1893, the conservation of mass in chemical reactions was tacitly assumed in all chemical work. In that year H. Landolt published a memoir in which the validity of this assumption was submitted to an experimental control under modern conditions; in no case were any changes in the total mass of the reacting substances observed outside the limits of experimental error. In a second paper, however, published in 1906, experiments carried out with an improved apparatus appeared to show a slight decrease in forty-two out of fifty-four observations. In a series of control experiments, carried out with vessels in which no chemical reactions were taking place, this decrease was not observed, and Landolt suggested the emission of electrons during chemical reactions as a possible cause of this loss. In last month's number of the *Zeitschrift fur physikalische Chemie* the same author contributes a third paper on this subject. In this the slight losses noticed in the earlier paper are traced down to minute volume changes in the glass vessels employed, the after effects of the slight temperature changes accompanying the chemical phenomena. The final conclusion drawn from the results of all the experiments is that no change of mass can be detected as a result of chemical reactions, and the law of the conservation of mass in this case is true within the very small limits of experimental error. Apart from the interest attaching to the rigid proof of this law, universally assumed in all chemical work, the present memoir goes very fully into the effects of changes of temperature on the volume and moisture films of glass vessels, a question arising in all chemical and physical researches involving the accurate weighing of substances in glass.

A catalogue of electrical novelties received from Messrs. F. Darton and Co., Clerkenwell Optical Works, London, E.C., contains descriptions of many simple and cheap motors, dynamos, coils, and other apparatus. The list should be of service in suggesting suitable Christmas presents for youths and others interested in electricity.

A list of microscopes and accessories just issued by Messrs. Ross, Ltd., the well-known manufacturing opticians, should be seen by everyone contemplating the purchase of a microscope for pleasure or work in various departments of science. The instruments described are of a high level of construction and efficiency, and each part has been designed with care. The catalogue also contains particulars of new photomicrographic apparatus.

OUR ASTRONOMICAL COLUMN.

Morehouse's Comet, 1908c.—Writing to the *Astronomische Nachrichten* (No. 4284, p. 194, November 21), Prof. E. C. Pickering transmits a message from Prof. Frost directing attention to the increased brightness of Morehouse's comet towards the end of October. It was easily seen, at the Yerkes Observatory, with the unaided eye, whilst with a small field-glass three or four degrees of tail became visible. With the Zeiss ultra-violet objective-prism camera three exposures on spectrum plates were made by Mr. Parkhurst and Prof. Frost, two of them each of one hour's duration. At the time of writing the measurement of the spectra was not complete, but Prof. Frost suggests that they are of the ordinary hydrocarbon type. As no continuous spectrum is perceptible, it is concluded that the radiations at the time of exposure (October 28) were, to a very large extent, intrinsic.

Prof. Pickering reports that photographs taken at the Harvard Observatory on October 30 show a tail at least nine degrees in length, much longer than on previous nights.

Further evidence of the changes which took place in the appearance of the comet, especially at the end of September and beginning of October, comes from Herr Winkler, of Jena, who observed with a 6-inch refractor. In his notes, published in No. 4280 of the *Astronomische Nachrichten* (November 6), he states that no tail was seen on October 1, although on September 28 a tail 40′ in length was observed.

Numerous measures of the comet's position are given in No. 4283 of the *Astronomische Nachrichten*, whilst in No. 4285 of the same journal M. Geelmuyden gives the positions (1900) and corrections for fifty-two comparison stars, extracted from a series of meridian observations of stars between 65° and 70° N. declination, made at the Christiania Observatory during the period 1897–1907.

From Herr Ebell's ephemeris, and Dr. Smart's continuation of it, we give the following abstract:—

Ephemeris (Greenwich midnight).

1908	R.A. h. m.	S. decl. ° ′	1908	R.A. h. m.	S. decl. ° ′
Dec. 3	18 50·3	8 11	Dec. 15	18 50·0	15 6
7	18 50·2	10 38	28	18 49·9	21 34
11	18 50·0	12 56			

THE CHANGE IN THE PHYSICAL CONDITION OF NOVA PERSEI.—According to the spectroscopic evidence published by Dr. Hartmann, Nova Persei changed to the nebular condition in the autumn of 1902, whilst later, in 1906, its spectrum was similar to that of the Wolf-Rayet stars.

Prof. Barnard now publishes a series of measures of the star's focus, made with the 40-inch refractor of the Yerkes Observatory between August, 1901, and September, 1903, and a number of notes regarding the Nova's appearance up to September 20 of the present year, which may throw more light on the details of the various changes.

At first the focus was that of an ordinary star, but between 1902 August 29 and October 6 it increased nearly a quarter of an inch, and became the same as that for a nebula; then from November it began to return to the stellar focus, and by the summer of 1903 the focus was essentially stellar. As no further changes were observed the focus measures were then discontinued.

Prof. Barnard also made focal measures of seven Wolf-Rayet Stars, and found that the focus generally appears to be shorter than for an ordinary star, whilst the stars are yellowish, and in some cases appear to be surrounded by a glow or halo (*Astronomische Nachrichten*, No. 4285, p. 201).

REFRACTION DUE TO JUPITER'S ATMOSPHERE.—In a recent note in the *Astronomische Nachrichten* (No. 4272), M. Chevalier published an account of an observed occultation of a star by Jupiter, and directed special attention to the fact, without offering any explanation of the phenomenon, that the star did not disappear at the point of the planet's limb to which its apparent motion, in regard to the planet, was directed some minutes before; that is to say, the star's apparent path was deflected immediately before immersion took place. In No. 4285 of the same journal (November 24, p. 206) M. E. Esclangon offers an explanation of the phenomenon. It is that the apparent deflection is caused by the horizontal refraction at the surface of Jupiter, and he finds that the observed direction and amount of the deflection are in good accordance with the theoretical value for the refraction. Although the disappearance of the star was apparently instantaneous, a diminution of light, such as might be caused by the absorption due to the planet's atmosphere, was observed.

OBSERVATIONS OF THE ZODIACAL LIGHT.—At the suggestion of Prof. Campbell, Mr. E. A. Fath made a number of observations, at the Lick Observatory, during the past summer, in order to determine, if possible, the true nature of a faint light which has for years been observed along the northern horizon from Mount Hamilton during the summer.

The observations show that it is probably due neither to twilight nor the aurora borealis although the strong aurora line at λ 5571 was observed spectroscopically both within and without the illuminated area—but to the zodiacal light. Details of the observations are given at length, and they show that the northern boundary of the light reached an altitude of 46° (Lick Observatory Bulletin, No. 142).

L'ANNUAIRE DU BUREAU DES LONGITUDES.—This annuaire, for 1909, is now published, and contains the usual very complete series of tables for use in astronomical, meteorological, geographical, and general scientific work.

The article "Spectres des Étoiles," which used to be written by the late M. Cornu, is replaced by a most interesting *résumé* of stellar spectroscopy prepared by M. A. de Gramont. This will be found very useful for reference, as it contains a brief account of the various stellar classifications of Secchi, Pickering, Lockyer, and others, with notes on their correlation. The annuaire is published by Gauthier-Villars, Paris, at 1.50 francs.

THE CORRELATION OF THE TEACHING OF MATHEMATICS AND SCIENCE.

IT is known that for some time past the Mathematical Association has been arranging for a joint committee with the Association of Public Schools Science Masters to report on the teaching of mathematics in connection with science. In furtherance of the same object a conference was held at the Regent Street Polytechnic on Saturday, November 28, between the Mathematical Association and the Federated Association of London Non-primary Teachers, the main feature being an address by Prof. John Perry, F.R.S., bearing the title of this article.

Prof. Perry said that a certain senior wrangler had objected to the name mathematician being applied to a mathematical physicist, and he therefore confined the term to those who were enlarging the scope of pure mathematics. Mathematicians, instead of being able to devote themselves to research, were forced to teach elementary classes; they also took part in examinations, and sometimes wrote treatises on hydrostatics, which were really books on integral calculus with such terms as pressure and depth.

The consequence was that too much attention was given to so-called rigorous proofs, and boys wasted much time in learning such subjects as deductive geometry, artificial devices for solution of triangles, and drudgery with algebraic symbols. The conditions of one examination at one British university had led to the creation of 90 per cent. of elementary algebra and trigonometry in Great Britain, this unnecessary 90 per cent. being as complex and tricky as it was possible to make it. Until this sort of thing was done away with the marriage of mathematics and science was like that of December and May. He alluded to the arbitrary division of examinations into water-tight compartments headed "Algebra," "Trigonometry," "Mechanics." He maintained that students ought to learn to use logarithms, and even Fourier's theorem, long before they could prove their methods. He thought school lessons should be on the type of Sandford and Merton and Mr. Barlow. There should be no division into subjects. Boys should learn to weigh and to measure, to calculate and to find things out for themselves. The form-masters should be all-round men, not specialists. There should be one teacher to every ten boys, and that teacher should be well paid. Every master should be responsible for English composition. If a boy wrote a description of anything he had done in a laboratory or elsewhere, it should be an exercise in English. He referred to the methods of teaching adopted by Dr. Andrews, of carbonic acid fame. Continuing, it astonished him to see how little comprehension there was of the proposals of the British Association committees. They recommended some work with graphs on squared paper, and some teachers did nothing but graphs, and there were dozens of school-books to help on the craze. The surprising thing was that many teachers seemed to have no individuality, no originality, nor even the power to think for themselves at all. He asked that the changes that were taking place should go on unchecked. Mistakes would be made at first, and it was their duty to make the public believe in the necessity for better paid teachers in order to attract really able men.

Prof. Bryan, who occupied the chair, thought Prof. Perry attached too much importance to the distinction which an idealist drew between a mathematician and a mathematical physicist. Consequently, his address tended to give the impression that the man who did research in pure mathematics was at the root of all the evil. In Prof. Bryan's opinion the fault rather lay with those whose only idea of research consisted in inventing

"pretty" questions unsuitable for a three-hours' examination paper. At Bangor Mr. Lloyd George had directed attention to the need of explorers who should survey the unknown regions of science. This need was urgently felt in mathematics, both pure and applied. Thus the theory of groups was a newly explored territory which might in time become a field of wealth in the hands of colonists like Prof. Perry. The true explorer would never stand in the way of progress. It was the man who thought he had done everything when he had competed in a walking race over the measured mile of a syllabus who never became an explorer, and never produced explorers. No man who relied only on his powers of walking would ever become an explorer. We required men to be carried over the greater part of the distance by the fastest means of locomotion at our disposal to bring them to the forefront of the unknown territory, and this was in effect what Prof. Perry wished to do. The research mathematician was in reality assisting, not hindering, progress. He had exposed the futility of elementary deductive geometry by raising the foundations of geometry to the level of a very difficult and advanced subject of post-graduate study. As for Fourier's theorem, modern researches had made the proof of that theorem a subject involving years of study, thus rendering it impossible for the science man to do more than study its applications. As for examinations, Prof. Bryan was thankful he had not been debarred from conducting them, as this work had afforded him most valuable experiences, and, referring to Prof. Perry's remarks on the solution of triangles, he gave a striking illustration of the cumbersome methods adopted by examinees in finding the area of a right-angled triangle by the unnecessary use of formulæ. There was far too much teaching and far too little learning. Prof. Perry lamented the lack of individuality on the part of teachers, and at the same time condemned the specialist teacher. Prof. Bryan, on the other hand, thought that the cause was that the teachers were not sufficient specialists to develop original ideas, and that an all-round man who was put on to teach mathematics, Latin, history, geography, Welsh, and chemistry could never (except in rare instances) get beyond blindly following the text-book or the examination syllabus.

Mr. Godfrey next spoke. He said that subjects such as mechanics, hydrostatics, and optics were, as a rule, taught in one way by the mathematical master and in another by the science master. He would throw the whole teaching of these subjects, both theoretical and practical, on the mathematical master. There was no educator so good as responsibility. The mathematical master would benefit by having the experimental work thrown on his shoulders; the science master would have more time for other work.

The reference to optics might well have been dwelt on at greater length. There is no better exercise in constructive geometry than the construction of reflected and refracted rays, caustics, and images, and the subject is capable of exact experimental verification, thus differing from the study of the motion of impossible particles on equally impossible smooth curves. Mr. Godfrey further pointed out that the clock sums and problems on filling baths had plenty of counterparts in the form of questions on graphs.

Mr. Jackson quoted Emerson's view that education was what remained when everything learnt at school was forgotten. There was no one panacea for inaccuracy. He recommended for graphs the use of a board with invisible squares scratched on it, identical in principle with the boards used by lightning caricaturists in music halls. He referred to the great French logarithmic tables, the computation of which was done by hairdressers who had been thrown out of work by the Revolution. We wanted to make boys believe that mathematics was a useful element in daily life, and not a punishment for their sins.

Prof. Alfred Lodge thought that in the higher forms boys taking mathematics might dispense with experimental work. He suggested that lists might be drawn up of experiments suitable for illustrating mathematical principles, and, conversely, that in science text-books each chapter might be prefaced by a list of mathematical formulæ.

Mr. W. J. Dobbs put in a plea for deductive geometry, which, he contended, was really a branch of experimental physics involving properties of matter. He referred to the value of mechanics in teaching trigonometry. He pleaded for the use of simple, inexpensive home-made apparatus, and contended that a great deal of money now spent on costly apparatus should be given to the teachers. Mr. Tuckey pointed out that two subjects taught by the same teacher were not necessarily correlated.

Prof. Armstrong suggested that Prof. Perry would have to tell teachers absolutely what they ought to do. People would be glad to learn, but they were not at present competent to understand his methods. Mathematicians must take off their coats and use their hands. The majority of pupils should not be trained from the scholarship point of view. He asked if there was any particular value in any educational subject.

After Mr. Nunn had spoken the latter question was again raised by the chairman, and Prof. Perry emphasised the necessity of differentiating between subjects which were useful in themselves and subjects which were educationally useful. Every child should be fond of reading and should be good at computation. He should have an elementary knowledge of science, and be able to express his ideas clearly in English. Lord Roberts's statements regarding the incompetence of men from the public schools when on service during the South African war were quoted. Prof. Bryan urged those present of the necessity of fighting that *practical* mathematics should receive its proper importance in the training of the working citizen, and that it should not be ousted by subjects the study of which had once formed the luxury and pleasure of the now vanishing English middle classes, but had only given rise to sadness and disappointment when these classes had been forced to earn their daily bread in the world at large. A vote of thanks was finally proposed by Mr. Siddons, who gave illustrations of the reforms that had actually taken place in recent years largely at the instigation of Prof. Perry.

SCIENTIFIC INVESTIGATIONS OF FISHERIES.[1]

TO the scientific inquirer the issue of these reports is, on the one hand, interesting for statistical and other proofs of the actual condition of the British sea-fisheries, and, on the other, for a statement of the views of impartial men—especially concerning the measures, if necessary, to be adopted for the preservation and improvement of the fisheries.

In the annual report of the English fisheries for 1906 it is gratifying to find that the quantity landed exceeded that of any previous year, and, if corroboration were necessary, the report of the Scotch Board for that year, and also for 1907, tell the same tale. It is further satisfactory to observe that by the methods now adopted the report is more nearly brought into line with modern requirements, and reflects credit on the Board and its staff. It may be pointed out, however, that the terms "demersal" and "pelagic" as applied to the food-fishes (and very suitable for their ova) are not free from misinterpretation even by fisheries' authorities, and it may be that the old terms "round" and "flat" white fishes and "skate," as distinguished from "herrings, mackerel, pilchards, sprats and anchovies," would prove as useful and at the same time be in accordance with the classification adopted by the Scotch Board. It is suggestive, again, that in the south dabs are included in the "decreasing" flat fishes, whereas the Scotch Board lately considered that this abundant form was usurping the areas of the more valuable plaice. The growing scarcit of marketable plaice is anxiously recorded, yet it is a complaint of very old date, and it has not been shown that the numbers of very small plaice show any diminution. The statistics of the average catch of this fish per day during the years 1903–6 must be cautiously accepted, since there

[1] (1) Annual Report of the Board of Agriculture and Fisheries under the Acts Relating to Sea-fisheries for the Year 1906 (1908).
(2) Report of Research-work of the Same Board on the Plaice Fisheries of the North Sea, 1905–6 (1908).
(3) Report of the Committee appointed by Treasury-Minute to inquire into the Scientific and Statistical Investigations now being carried on in Relation to the Fishing Industry of the United Kingdom.

are factors not included in the reckoning, but the adoption by the Board of a chart in which the fishing-grounds of western Europe are divided into "regions" and the North Sea into "areas," according to depth, is excellent, especially in connection with plaice and other flat fishes. In briefly noticing the nature of each area, it is stated that the fishes caught in the North Sea no longer constitute the predominant quantity of a few years ago, but rather more than half the total quantity of "demersal" fishes landed by British vessels, yet the reader is left in doubt concerning the nature of the statistics of a few years ago, and as to whether the recent statistics of the International Bureau have been taken into account. It is interesting that the most prominent fish is the haddock, as in Scotland, a fish about which as many misgivings have been bruited as about the plaice.

On the whole, the report, its foreign and colonial information, and its elaborate, skilfully arranged and important tables, ought to assuage unnecessary fears as to the yield of the sea. It is true statistics are at most approximative, and need the support of scientific experience and a thorough acquaintance with the waters in, as well as adjacent to, the North Sea, both of which were absent, for instance, in the statistics laid by the Scotch Board before the Parliamentary Committee under Mr. Marjoribanks in 1893, but they are indispensable. In all probability the Board will arrange for a more expeditious issue of the report in future. The Scotch Board's report for 1907 is now in hand.

Little need be said about the special report on plaice, by Captain W. Masterman, further than that in its present stage it demonstrates the ability and infinite pains taken by its author in the methods of weighing and measuring specimens from the various "areas" of the North Sea. Four "ichthyometric" ports have been chosen, viz. Grimsby, Boston, Lowestoft, and Ramsgate, and the series of elaborate tables giving the number of large, medium, small, undistinguished and others, from each area, and also their condition as to the viscera, show that every available fact will be grasped. In future reports, no doubt, a record from each area, and from personal observation, of the captures of plaice under 19 cm. which have been thrown overboard before returning to land, will be given, for such would be invaluable in placing the whole subject before the investigator. The use of the small-meshed ground-net of St. Andrews and the various surface- and mid-water nets on each area will probably also add further information. The reported fall from 48 million kilos. in 1903 to 29 million kilos. in 1906 merits full investigation. A careful summary of the captures of plaice from the North Sea by other nations would also be useful, especially as Dr. Kyle has shown that the totals of plaice landed at all the North Sea ports were nearly doubled between 1892 and 1903, and that, ten years after Dr. Petersen had reported the gradual decline of the Danish plaice-fishery in the Cattegat, not only was it more productive, but, as if to emphasise the lesson, an entirely new plaice-fishery by the Swedes on the northern border of the same area had sprung up and was flourishing. Experience demonstrates that when much harrassed and their ranks thinned, the older plaice become, like other fishes, extremely wary, but the vast swarms of very young plaice have shown no diminution on any shore, for it was pointed out long ago (1884) that none occur in deep water. Even a small untrawlable area is of importance in such a question, and it is stated that, in regard to plaice, 17 *per cent.* of the area of the North Sea is so. Much information may also be procured by the use of plaice-nets on suitable grounds, especially if diminution is reported. Moreover, the misunderstanding of the Scotch Department in summarising the ten years' work of the *Garland* should be borne in mind. The whole question is so complex that any new facts obtained by the able scientific staff of the English Board would be very welcome.

The third and very important report is that of the committee on the scientific and statistical investigations, and the task was one which even the special experience of a long life may well have faced with diffidence; yet the fact that the secretary of the commission was the only one specially trained on the subject may have had its advantages, since unbiassed minds would thus be brought to bear on the complex question. In this brief notice, however, it is only possible to make a few general comments, and to allude to the main features of the recommendations—premising that the report, in its comprehensive nature, moderation, and fairness, is worthy of the committee.

In the interesting historical summary of scientific fisheries' work ample justice is done to England, but it is not shown with sufficient clearness that it is to Lord Dalhousie's Commission (1883–5) that the country owes the scientific and statistical initiative in the department, and that ever since such work has been as conspicuously Scotch as English. Further, that many of the recommendations in that report (1884–5) have been utilised by the Scotch, English, and Irish Boards—in some cases for many years, whilst others are again brought up in the present report. Amongst other things, it is curious that the herring-brand of the Scotch Board has apparently been thought more important than the ten years' unique work of the *Garland* and the scientific conclusions therefrom, and that the work of the recently formed Ulster Marine Biological Association is duly noted, whilst the committee appears to be unaware of the existence of the oldest marine laboratory in Britain for scientific fisheries' work. The account of the *personnel* of the British section of the international investigations and the historical summary might well have been abbreviated. In their outline of future investigations the committee has prudently followed what has previously been advised (*minus* hydrography and chemistry, both of which are somewhat expensive, whilst the results to the fisheries have been small). Artificial hatching for the stocking of the sea also is, so far as observed, an unnecessary task.

A central fisheries council, representative of the three divisions of the kingdom, as suggested, has much to recommend it, but it would be well to consider—on the score of efficiency and expense—whether one instead of two members from each division would not suffice, the Treasury appointing the other two, after consultation with the Royal Society, not the Meteorological Office. No fault can be found with the restriction of the labours of the council to researches and statistics affecting the common interests of the sea-fisheries of the United Kingdom, and to the other duties stated, provided due attention is given to uniformity of method in the annual reports of each division. Yet a further step is worthy of consideration, viz. the severance of the Fisheries' Department from agriculture and its representation in Parliament by a responsible Minister, as the minority report so far indicates. In regard to the continuance of the grant of 1000*l.* *per annum* to the Plymouth Laboratory—with the necessary reservations—no dissentient voice will be heard amongst men of science. There can be no question as to the expediency of appointing a scientific officer and scientific assistants to the English Department of Fisheries. It is difficult to explain why this has so long been delayed. Nor is there any objection to the committee's scheme for international cooperation or to the International Council on the lines indicated. The sea is the highway between nations, and to a large extent their common fishing-ground. It is to be hoped that the Government will, in the main, give effect to the committee's judicious recommendations.

W. C. M.

THE EUROPEAN POPULATION OF THE UNITED STATES.

PROF. RIPLEY, in his Huxley lecture delivered recently before the Royal Anthropological Institute, on the European population of the United States, raised a number of novel and important problems, for the solution of which the evidence is at present insufficient. In contrast to Europe, where the existing races have grown up from the soil, in America they, "one may say, have dropped from the sky. They are in the land, but not yet an integral part of it. They are as yet unrelated to its physical environment." Further, the influence of environment on this diverse population is as yet little more than a matter for speculation. The day has passed for assuming that the modern American type is a reversion to that of the American Indian; but for the future of this foreign population suddenly planted among new surroundings we must

depend more upon speculation than upon prophecy, because as yet, except in the classical records of the armies recruited in the Civil War, anthropological statistics are not available.

The extent of this foreign invasion of the country is stupendous. Twenty-five million emigrants have landed since 1820, and in 1907 no fewer than one and a quarter million souls were added to the population; and, what is still more remarkable, the source of supply has completely changed in recent years. A quarter of a century ago two-thirds of the annual immigration was in origin Teutonic or Anglo-Saxon; at present less than one-sixth is derived from this source. The newcomers are now mainly south Italian, Russian, or Austro-Hungarian. "We have even tapped the political sinks of Europe, and are now drawing large numbers of Greeks, Armenians, and Syrians." Ninety per cent. of the tailors of New York are Russo-Polish Jews; all day labourers, once Irish, are now Italian; fruit-vendors, once Italian, are now Greek. Chicago is now the second Bohemian, the third Swedish, the fourth Polish, the fifth German city in the world.

The question then arises, Will these racial groups coalesce into a more or less uniform American type? In dealing with this problem, Prof. Ripley discusses the causes which promote and those which operate to prevent the union of these races. On the one hand, as tending to combination, he notices the extreme mobility of the newer industrial immigrants, and their readiness to wander into the most distant parts of the country in search of employment; the inequality of the sexes, males being in a large majority, which results in marriage of the newcomers with locally born women. In this connection, he remarks the tendency of the male as he rises in the world endeavouring to improve his social position by marrying into a class higher than his own. The main cause which checks further union of the races is the concentration or segregation of the immigrants in compact industrial colonies or in the large cities of the west. While the Teutonic races wander far afield as colonists, the Mediterranean, Slavic, and Oriental races herd in the towns.

An investigation of marriage statistics brings out many interesting facts. Even in the case of the Jews, the most exclusive of peoples, there is more intermarriage than is commonly supposed, the Jews in Boston constantly taking as wives Irish or Irish-American women. All the facts of marriage and birth-rates, however, indicate a relative submergence of the Anglo-Saxon stock in the near future. While the birth-rate among them is steadily declining, the fecundity of the foreign races newly arrived in the country shows little signs of diminishing. In Massachusetts the birth-rate of these two races is in the proportion of about one to three. This superiority will probably not be maintained, as even now the fecundity of the foreigners seems to be diminishing after the second generation; but their vitality under a favourable environment is remarkable.

As Prof. Ripley observes, this race struggle is only in its very earliest stage, and it remains to be seen whether the Anglo-Saxon will be able to preserve and transmit his characteristic culture over these hordes of foreigners.

America, including Canada, is thus confronted with a novel series of problems, racial and social, and to add to these she has to deal with a fresh set of difficulties connected with the Negro and the Filipino, with which Prof. Ripley was unable to deal in this address. He cherishes a pious hope that a satisfactory solution will be attained; but this lies in the lap of the future, and it will be well that this notable address should attract on both sides of the Atlantic the attention which it deserves.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The general board of studies recommends the appointment of an assistant to the Quick professor of biology. It is proposed that Prof. Nuttall should appoint him with the approval of the Vice-Chancellor; the appointment will terminate on the appointment of a successor to the present professor. It carries with it a stipend of 100*l*. a year.

It is suggested to increase the stipend of the curator of the botanic garden to 350*l*. a year. It is now nearly thirty years since the present curator was appointed, and the position the Cambridge Botanic Garden now occupies is largely due to Mr. Lynch's ability and devotion.

PROF. R. C. MACLAURIN, professor of mathematical physics in Columbia University, and previously professor of mathematics in the University of New Zealand, has accepted, we learn from *Science*, the offer of the presidency of the Massachusetts Institute of Technology.

THE Chelsea Secondary School for Girls was formally opened on November 20. The school was originally part of the South-Western Polytechnic, and the transfer was effected in September last. The new buildings are situated in Hortensia Road, and represent the first school building expressly designed and erected by the London County Council for the secondary education of girls. The aim of the new school is to provide a liberal education for girls up to the age of eighteen or nineteen years. The claims of science to a prominent place in the school curriculum have been duly recognised, and ample accommodation has been provided for the practical study of chemistry, physics, and botany. The home arts are to be taught, and suitable rooms have been arranged for this purpose, as well as for practical work in geography.

THE report of the principal of the Bradford Technical College for the session 1907–8 shows that the total number of students in attendance during the session was virtually the same as in the previous year; but there was, unfortunately, a fall in the number of day students from 242 to 217. The average age of these students at the commencement of the session was nineteen years, as compared with eighteen years five months at the corresponding period of 1906. We notice that a new scholarship scheme has been adopted during the session. It provides opportunity for the transference of evening students of exceptional ability to the day courses, and offers special scholarships for apprentices in works. In order to carry the specialised training to as high a point as practicable, a number of fourth-year scholarships are offered to day students who have completed their three years' course, and as a recognition of the necessity for securing the best brains and the highest possible preliminary training a certain number of entrance scholarships are awarded on merit alone. The scheme affords evidence of the desire that all sections of the community should have equal facilities, as they have an equal claim to the advantages of the college training. The scheme for building a new block for the accommodation of the department of textile industries on an adjoining site already purchased has taken definite shape; detailed plans are being prepared, and building is to be begun shortly. The staff of the department of chemistry and dyeing has been strengthened with the view of the encouragement of research work in the college. The testing laboratory of the department of textile industries has been employed to a much greater extent than previously in carrying out investigations for the trade. It is pleasing to note that the advantages offered to manufacturers and others are being more fully realised.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 13.—Dr. C. Chree, F.R.S., president, in the chair.—The photoelectric properties of potassium-sodium alloy: Dr. **Fleming**. It is well known that, under the action of ordinary and ultra-violet light, the electro-positive metals lose a negative charge of electricity, the effect being most pronounced in the case of rubidium, potassium, and the liquid alloy of potassium-sodium. Potassium and sodium are melted together and then decanted over into a chamber containing a platinum plate, so that a mass of the liquid potassium-sodium alloy having a perfectly clean surface was obtained in a glass tube, and a platinum plate was fixed above it in an inclined position.

By means of platinum wires sealed through the glass tube, a contact is made respectively with the platinum plate and the liquid alloy. When the surface of the alloy is illuminated by a powerful beam of light, and the galvanometer connected to the platinum plate and alloy, it is found that a current is produced in this circuit merely by the action of the light, and by balancing this current against a variable electromotive force it was shown that an electromotive force varying from 0·4 to 0·8 of a volt is produced in the photoelectric cell due to the action of the light. This photoelectric effect was greatly dependent on the colour of the light, and especially upon light absorbed by the alloy. It is greatly diminished by making even a feeble magnetic field parallel to the surface of the alloy. Some questions were discussed tending to show that the source of the photoelectromotive force cannot be identical with the volta-contact electromotive force in the circuit, but is due to the absorption of light by the sensitive surface. In all cases of such photoelectric action, the rays which are effective in producing it are those given out by the substance if heated or otherwise made radiant. Thus, zinc is photoelectric under the action of ultra-violet light, and ultra-violet light is largely radiated when an electric spark is taken between the zinc balls, or an electric arc between zinc poles. The photoelectric effects in the case of potassium are probably due to the absorption of the violet ray emitted by potassium when heated.—Electric splashes on photographic plates: A. W. **Porter.** The author showed, by means of transparencies, the effect of a normal magnetic field upon the patterns which appear in developing a photographic plate which is placed between two terminals between which a sudden discharge passes. This effect is confined to the main line of discharge, and consists in this line being broadened into a band of nearly constant width; a very similar result is obtained if a blast of air sweeps across the plate instead of the magnetic field being employed. This broad band is produced by the glowing gas which surrounds the spark itself. The palm-like figures and the ramifications leading up to them do not seem to be modified by the magnetic field, and the author concludes that these figures are, therefore, determined by events independent of the *motion* of the changes conveyed along them, or else that the moving charges have a very large mass associated with them.—An anomaly in the lagging of thin wires and narrow pipes: A. W. **Porter.** When thin wires and narrow pipes are covered with a lagging material, it is not possible at once to say whether the covering will keep heat in or assist it to escape. There is a critical radius equal to the ratio of the conductivity of the material to the emissivity from its surface which the outer covering must exceed before it begins to act as a lagger. Although this seems to have been recognised by Prof. Bottomley and others, the results of experiments which have previously been made would seem to indicate that the effect in practice is very small indeed. The author showed a simple lecture experiment in which a large effect is obtained.—The rate of growth of viscosity in congealing solutions: A. O. **Rankine.** The author exhibited apparatus and described experiments for the determination of the time variation at constant temperature of the viscosity of gelatin solutions of high concentration.—Note on the re-combination of ions in air: Dr. **Phillips.**

Royal Astronomical Society, November 13.—Mr. H. F. Newall, president, in the chair.—Photographs of comet *c* (Morehouse), taken at the Royal Observatory, Greenwich: **Astronomer Royal.** The first photograph was obtained on September 4, and subsequent plates showed such remarkable changes that it was arranged that the comet should be photographed at very short intervals. Mr. Davidson and Mr. Melotte had obtained a long series of negatives, often at intervals of an hour or less, and lantern slides from these were shown on the screen. They were mostly taken with the 30-inch reflector, a shorter series being obtained with a $3\frac{1}{2}$-inch portrait lens. The tail exhibits a recurring series of phases, and the phase seems to bear a relation to the condition of the nucleus, which passes through cycles of alternating activity and quiescence. A series of photographs taken by Prof. Barnard with various lenses at the Yerkes Observatory was shown on the screen, and Mr. Percy Morris showed another series taken by himself. Father Cortie said that his measures of the plates showed that matter ejected from the nucleus moved with an accelerating velocity. The Astronomer Royal and the president directed attention to dark rays in some of the photographs.—Note on the number of faint stars with large proper motions: H. H. **Turner.** The number of faint stars with motions of more than 20″ per century was singularly small.—The absorption of light in its passage through interstellar space: H. H. **Turner.** If the universe is infinite, the number of stars would theoretically be four times greater for each fainter magnitude, but, as observed, it was only three times greater. The hypothesis that light is absorbed by scattered material particles would apparently explain the discrepancy, and photography with coloured screens was suggested as a crucial test.—Mr. Cookson showed Prof. **Hale's** spectroheliographs, exhibiting vortex motion on the solar surface, especially connected with sun-spots. Vortices north and south of the solar equator appeared to move in opposite directions.—The calendar dates in Aramaic papyri from Assuan: J. K. **Fotheringham.**—Note on the regnal years in the Aramaic papyri from Assuan: E. B. **Knobel.**

Zoological Society, November 17.—Prof. E. A. Minchin, vice-president, in the chair.—A new genus and species of slow-lemurs from the Lushai Hills, Assam: Dr. N. **Annandale.** The animal is known only from a photograph of two individuals taken in 1889 by Mr. T. D. La Touche, and resembles Nycticebus in appearance, but has a long, bushy tail, which distinguishes it from all known Oriental lemurs.—Contributions to the morphology of the group Neritacea of aspidobranch gastropods, part i., the Neritidæ: Prof. G. C. **Bourne.** As a result of the comparative study of the anatomy of several species of marine, estuarine, and freshwater Neritidæ, the author found that the forms hitherto classed in the genera Nerita, Neritina, and Septaria fall into three well-known groups of subgeneric value, the chief distinctive characters relating to the accessory genital organs. The investigation had been pursued by the study of sections as well as by dissections, and a number of important anatomical results were set forth.—An account of the expedition organised to collect in the Ruwenzori range of mountains in Equatorial Africa: W. R. **Ogilvie-Grant.** The results were extremely successful, amongst the specimens obtained being 404 Mammalia, 2470 Aves, 135 Reptiles and Batrachia, 31 Pisces, and a very large number of invertebrates. A number of memoirs on the zoological results of the expedition were presented to the meeting, and will be published in the Scientific Transactions of the society.

Mineralogical Society, November 17.—Prof. H. A. Miers, F.R.S., president, in the chair.—Mica from North Wales and chlorite from Connemara: A. **Hutchinson** and W. Campbell **Smith.** A mica from Tan-y-bwlch, North Wales, is found in pale green scales in quartz veins, and approximates closely in composition to the variety of muscovite known as sericite. A chloritic mineral from Recess occurs in transparent hexagonal plates in the quarry whence the Connemara marble is obtained. It is nearly uniaxial and positive, and was found on analysis to have the composition of penninite.—The occurrence of the rare mineral carminite in Cornwall: A. **Russell.** This mineral, an arsenate of iron and lead, first found at Horhausen, Rhenish Prussia, and described by F. Sandberger in 1850, was discovered in Cornwall by the author in 1906. It occurs as carmine-red or brown needles on crystallised scorodite, mimetite, &c., from Hingston Down mine. This adds one more species to the already long list of rare minerals yielded by Cornwall.—Russian universal instruments and methods: T. V. **Barker.** Several of the universal instruments devised, and kindly lent, by Prof. E. Fedoroff were exhibited, and the method of working explained. Among the instruments described were the hemisphere and graduated rotatory quartz compensator of Prof. V. Nikitin, the stereographic rule, circle-ruler, graduated mica and quartz compensators, universal crystal mirror-models and globes, the microdichroscope, and the universal microscope-stage. The great utility of the latter

was demonstrated by the actual determination (using a simple projection apparatus and screen) of the optical constants, twin-law, and chemical composition of a plagioclase twin. Methods of determining birefringence and the thickness of a section were discussed, and emphasis was laid on the special usefulness of the three-legged compasses in rapid calculations by graphical methods.—The composition of the Chandakapur meteoric stone: H. E. **Clarke** and H. L. **Bowman.** This meteorite, which fell in India in 1838, is of chondritic type, with numerous chondrules of varying structure, and consists principally of olivine and bronzite, and about 5 per cent. of nickel-iron.

Geological Society, November 18.—Prof. W. J. Sollas, F.R.S., president, in the chair.—Some intrusive rocks in the neighbourhood of Eskdale (Cumberland): Dr. A. R. **Dwerryhouse.** There appear to be five well-marked groups of intrusions in this district:—(a) the andesitic dykes of Allen Crags and Angle Tarn; (b) the dykes of the spherulitic group on Yewbarrow and High Fell; (c) the dioritic bosses of Peers Gill, Lingmell Crag, and Bursting Knotts; (d) the Eskdale Granite; (e) the dolerite-dykes. The dykes of series (a) bear a petrological resemblance to the Borrowdale volcanic rocks, into which they were intruded. They appear to be of Borrowdale age, and roughly contemporaneous with the lavas and ashes into which they are intruded. The spherulitic series (b) are considered to be also of Borrowdale age, though probably somewhat later, and the rocks of group (c) to be the holocrystalline equivalents of the Borrowdale lavas, and they also are probably of Ordovician age. The Eskdale Granite (d) is more acid. It is undoubtedly intrusive into the Borrowdale series, but seems to be pre-Triassic. The intrusion is probably Devonian. The basic intrusions (e) have been examined only where they come into proximity to the granite.

Linnean Society, November 19.—Dr. D. H. Scott, F.R.S., president, in the chair.—The optical behaviour of the epidermal cells of leaves (see NATURE, November 19, p. 86): H. **Wager.**—A new species of Symphyla from the Himalayas: Prof. A. D. **Imms.**—The freshwater Crustacea of Tasmania, with remarks on their geographical distribution: G. **Smith.**

Royal Anthropological Institute, November 24.—Prof. W. Gowland, F.R.S., past-president, in the chair.—Primitive pottery and iron-working in British East Africa: W. S. **Routledge.** After explaining the method of obtaining fire by friction adopted by the natives, the author proceeded to demonstrate the method by which pots were made. No wheel is used, but the pot is most carefully worked up by hand. An interesting feature is that the pot is made in two parts. All pottery is made by the women. The interest of the description was greatly heightened by an exhibit of pottery in all the different stages of manufacture. With regard to iron working, the author explained the manner in which the iron is washed from the sand and the way in which it was smelted in a large crucible dug out of the earth. From the iron thus obtained implements are made, and a large selection of examples was exhibited. Iron wire is also drawn, and the author gave a demonstration of the manner in which this is done.

CAMBRIDGE.

Philosophical Society, October 26.—Note on Russo's attempt to show differentiation of sex in the ovarian ova of the rabbit: W. **Heape.**—A further note on the eggs of the hermaphrodite *Angiostomum nigrovenosum*: S. A. **McDowall.**—Plemelj's canonical form: J. **Mercer.**—Monotone sequences of continuous functions: Dr. **Young.**—The operator reciprocants of Sylvester's theory of reciprocants: Major P. A. **MacMahon.**

November 9.—Prof. Sedgwick, president, in the chair.—The carriers of the positive charge of electricity given off by hot metals: Sir J. J. **Thomson.** The paper contains an account of measurements e/m for the carriers of the positive electricity given off by incandescent metals. The method used was that described in a paper by the author on rays of positive electricity in the *Philosophical Magazine* for October, and is an improvement on that used by him to measure e/m for the particles given out by hot wires some years ago. The values of e/m given in the present paper, taken in conjunction with other evidence, suggest that the carriers of the positive electricity given out by hot wires are mainly molecules of carbon monoxide.—The weight of a corpuscle on the electrical theory of gravitation: Sir J. J. **Thomson.** It was shown that, on the theory that gravitation was due to slight differences between the forces between like and unlike charges of electricity, the acceleration of a corpuscle under gravity might be expected to be about one thousand times the acceleration of ordinary matter.—The distribution of electric force along the striated discharge: Sir J. J. **Thomson.** A Wehnelt hot-lime kathode was used to produce the discharge, as it was found that at low pressures the striations produced in this way were remarkably steady and bright, and in consequence made accurate measurements of the distribution of electric force much easier than with the ordinary discharge. It was found that just in front of the bright surface of a striation towards the kathode there was a reversal of the electric force. This reversal causes a great accumulation of ions in the part of the striation nearest the kathode; the re-combination of the ions in this region will therefore be much greater than elsewhere, and it is shown that a very simple explanation of the formation and behaviour of striations was given by the hypothesis that the re-combination of the ions was the source of the luminosity in the striations.—Note on the radio-activity of rubidium: N. R. **Campbell.** Measurements on rubidium have been made similar to those on potassium described in a recent communication. It is shown that the rays from rubidium are less penetrating than those from potassium, but that the total activity of the former metal is some seven times as great as that of the latter.—The free pressure in osmosis: L. **Vegard.** The work contains a series of experiments made in order to obtain some information regarding the mechanism underlying osmotic phenomena. The experiments consist in the determination of osmotic velocities developed in a membrane of copper ferrocyanide by solutions of cane sugar of different concentrations, together with the determination of the resistance of the membrane against the flow of solvent. The author concludes that in osmosis the solution is restricted to a very thin layer, and the motion in the rest of the membrane is caused by the so-called *free pressure*, which is a negative hydrostatic pressure inside the membrane produced by the osmotic activity in the layer next to the solution. It is shown that for small velocities the free pressure is equal to the osmotic pressure, and that for higher concentrations the free pressure corresponding to the stationary state is equal to the friction pressure necessary to produce a velocity equal to the osmotic velocity.—The laws of mobility and diffusion of the ions formed in gaseous media: E. M. **Wellisch.** Expressions have been deduced from the kinetic theory of gases for the mobility and coefficient of diffusion of an ion, allowance being made for the increase in collision frequency due to the polarisation of the neutral molecules by the charge associated with the ion. This charge is shown to be replaceable, so far as collisions are concerned, by an extension of the sphere of force of the ionic nucleus. The expressions given involve only known physical constants of the gas, and are therefore directly comparable with the values as determined experimentally. It is found that the observed values of the mobilities and diffusion coefficients, as well as certain deviations from the mobility-pressure law, can be approximately explained on the supposition that the ion consists of a single molecule of the gas with which is associated a charge equal to that carried by the monovalent ion in electrolysis.

MANCHESTER.

Literary and Philosophical Society, November 17.—Prof. H. B. Dixon, F.R.S., president, in the chair.—Contributions to a study of the geographical distribution of birds, part i., the genus Macronyx, Swainson: F. **Nicholson.** This paper, the first of a series embodying a mass of notes on the Motacillidæ (wagtails and pipits)

in the author's possession, the result of several years' work, deals with the genus Macronyx, and brings up to date the geographical memoranda detailed by Reichenow and Shelley. Macronyx is a purely Ethiopian genus, being confined to the African continent, where the birds are popularly known as "longclaws," from the abnormal development of their claws. They may be divided into two sections, those with a yellow or orange breast and those with a pink breast. *M. croceus*, one of the former, is the most widely distributed, being found over the greater part of Africa. The range of the others is more confined. Nine species in all were enumerated, and the range of each was shown.—The draught-inducing properties of the poker: A. H. **Gibson.** With the view of ascertaining whether there is any scientific basis for the belief that a poker, placed with its lower end against the fender and the other end reared against the bars of an ordinary fire-grate without actually touching the fire, is able to induce a recalcitrant fire to burn up or to burn less smokily, the author undertook a series of experiments, in which the velocity of inflow of air was measured at various points with and without the poker in position. The results showed that the magnitude of the effect was very remarkable. The explanation of the phenomenon appears to be that, when a current of air impinges on a fixed body, eddies are formed on its leeward side, where a region of low pressure (below that of the atmosphere) in consequence exists. There is a tendency to inward flow towards this from all surrounding regions, accompanied by a consequent inward and upward flow towards and along the under side of the poker and towards the fire, this taking place along its whole length, but particularly from its lower end, which is shielded from the direct influence of the draught.—Notes on the spawning of Eledone and on the occurrence of Eledone with the suckers in double rows: F. H. **Gravely.** The spawning of *Eledone cirrosa* was watched in the aquarium belonging to the Liverpool Marine Biological Committee at Port Erin. The female settles upon a vertical surface, to which she clings with the large suckers of the arms. The siphon directs a jet of water into the oral funnel, and then places the eggs there. They are held by the small suckers near the bases of the arms, and are arranged by these in a bunch, the free ends of their individual stalks being fastened by means of a glutinous secretion into a central cord, by which they are united together. When the bunch is completed its strength is tested by the parent, and then it is left. At first it is white throughout, but the central cord, and the disc of hardened glutinous material, by means of which this is attached to the substratum, very soon becomes green, probably through the growth of an alga. The genus Eledone can usually be distinguished from the genus Octopus by the arrangement of the suckers on each arm in one row in the former, but in two rows in the latter.

PARIS.

Academy of Sciences, November 23.—M. Bouchard in the chair.—The spectrum of the Morehouse comet: H. **Deslandres** and J. **Bosler.** This spectrum has been studied at Meudon with two different forms of apparatus, the prismatic chamber and the ordinary spectroscope with slit: the present note deals chiefly with the results obtained with the latter. Besides the principal bands of nitrogen and cyanogen, there are three bands of unknown origin, λ 456·1, 426·7, and 401·3, noticed for the first time in the Daniel comet of 1907. All these, together with two others (λ 453·1 and 470·0), have proved to be doublets. The cause of this is discussed, and the conclusion arrived at that this cannot be attributed to a Zeeman effect, the application of Doppler's principle giving the best explanation of the phenomenon.—The influence of isolated multiple points on the number of double integrals of the second species of an algebraic surface: **Emile Picard.** —A new method for determining position at sea: **E. Guyon.** —M. Bouty was elected a member of the physical section in the place of M. H. Becquerel.—Algebraic surfaces which represent pairs of points of the curve of genus three: **L. Remy.**—The geometrical applications of certain remarkable movements: **J. Haag.**—Differential equations and systems of reservoirs: **Edmond Maillet.**—The ratio of the charge to the mass of electrons. The comparison of the values deduced from the Zeeman phenomenon and recent measures on the kathode rays: A. **Cotton** and P. **Weiss.** All the lines of metals in Mendeléeff's second group, which belong to the second secondary series, have a single constant $K=\delta(\lambda)/H\lambda^2$, which completely defines the magnitude of the Zeeman phenomenon. The authors' values for zinc give $K=1{\cdot}875\times10^{-4}$, and this, applying Lorentz's calculation, leads to $e/m=2\times1{\cdot}767\times10^7$. A recent measurement by M. Classen, made with kathode rays of low velocity, gives $e/m=1{\cdot}773\times10^7$, exactly half that deduced from the Zeeman phenomenon. On the other hand, a recent study by Lohmann of the triplets formed in a magnetic field by the helium lines gives a value $e/m=1{\cdot}77\times10^7$, identical with Classen's figure. The concordance of these results with Lorentz's views affords a striking example of the power of the electron theory in connecting phenomena apparently entirely different.—The kinematographical study of the backwash and stream lines produced by the motion of an obstacle: Henri **Bénard.**—The atomic weight of silver: A. **Leduc.** A criticism of the conclusions drawn by Dubreuil in a recent note on the same subject.—The borotungstic acids: H. **Copaux.** A detailed account of the preparation and analysis of the two acids $B_2O_3.28TuO_3.62H_2O$ and $B_2O_3.24TuO_3.66H_2O$. The former has a molecular weight of 7682, possibly the highest of any known inorganic substance.—The action of antimony trichloride on nickel: Em. **Vigouroux.** These two substances interact with incandescence at 800° C., with the ultimate production of crystals of NiSb. The physical and chemical properties of NiSb are given in detail.—Study of the tartrates of the fatty and aromatic amines in the state of solution, making use of the rotatory power: J. **Minguin** and Henri **Wohlgemuth.**—The preparation of *o*-azocarboxylic acids: P. **Freundler** and M. **Sevestre.**—The theory of the preparation of methylamine by solutions of acetamide and bromine: Maurice **François.** The author holds that the bromacetamide of Hofmann does not exist in solution, and explains the formation of methylamine as the result of an oxidation of the carbonyl group in $CH_3.CO.NH_2$ by hypobromous acid or free bromine in presence of alkali.—The humic materials in coals: O. **Boudouard.** Humic acid has been isolated from various kinds of coal by treatment with aqueous potash solution, with or without previous oxidation by nitric acid. Analyses and approximate formulæ for the humic acids thus obtained are given.—Antique red porphyry: J. **Couyat.**—The quantitative control of work on chlorophyll: V. **Brdlik.**—The physiological mechanism of the coloration of red grapes and the autumnal coloration of leaves: J. **Laborde.** Tannin extracted from different parts of the vine, on exposure to the sun in solution containing small quantities of hydrochloric acid and formaldehyde, develops a deep red colour, and the author attributes the natural colour changes in both fruit and leaf to the alteration of the tannins present in these organs.—The physiological study of some alkaloids of hemlock (*Conium maculatum*): J. M. **Albahary** and K. **Löffler.**—New contribution to the study of the serum of animals after removal of the thyroid gland: L. **Launoy.** —Note on a map indicating the oceanographical distribution of marine plants in the Roscoff region: L. **Joubin.** —Studies on cancer in mice: L. **Cuénot** and L. **Mercier.** —Experimental growths, and, in particular, the production of a supplementary head in Saccocirrus: Aug. **Michel.** —The age of the iron ores of the forest of Lorges (Côtes-du-Nord): F. **Kerforme.**—The distribution of Halobia in the western Peloponnesus: Ph. **Négris.**—Continuous luminous effluvia during a storm at the island of Lifou: M. **Nicolas.**—A particular class of sea bottom near Thau: L. **Sudry.**—Earthquake shocks at Constantine: P. **Martel.**

CAPE TOWN.

Royal Society of South Africa, October 21.—Mr. S. Hough, F.R.S., president, in the chair.—Note on the structure of Tygerberg, Prince Albert: Dr. A. W. **Rogers.** In 1906 Dr. Sandberg published a paper throwing doubt on the anticlinal structure of Tygerberg as described by Mr. A. R. Sawyer and Prof. Schwarz. The present author spent a week in the country between Prince Albert and

the east end of the Tygerberg, in order to study the evidence for Dr. Sandberg's views. It seemed to him that the anticlinal structure of the range was clear, for at many places in it the Witteberg beds were seen to dip under the Dwyka on either side. The masses of quartzite in the Dwyka described by Dr. Sandberg appeared to be parts of that formation, *i.e.* originally sandy sediments with few or no pebbles, formed at the same time as part of the tillite. Similar quartzites in the Dwyka had been described from several localities in the south of the colony. An examination of Sand River valley showed not only that it was extremely unlikely that a mass of Witteberg beds underlay the surface, for those beds were not known to form valleys like that of Sand River, but that where outcrops of rock *in situ* occurred they belonged to the Ecca series. He had come to the conclusion that it was unnecessary to assume the presence of a great overturned fold to account for the appearances at Tygerberg, and that the earlier observers were quite justified in ascribing an anticlinal structure to the range.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 3.

LINNEAN SOCIETY, at 8.—Biscayan Plankton, the Ostracoda: Dr. G. Herbert Fowler.—Note on *Juniperus taxifolia*, Hook. and Arn.: Bunzō Hayata.—Mimicry in Spiders: R. I. Pocock.

RÖNTGEN SOCIETY, at 8.15.—Phenomena observed in Electrical Currents of Continuous Oscillation: Dr. H. Manders.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—The Influence of Track upon Railway and Tramway Carriages: J. S. Warner.

FRIDAY, DECEMBER 4.

GEOLOGISTS' ASSOCIATION, at 8.—Personal Experiences of the Jamaica Earthquake of 1907: Dr. Vaughan Cornish.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design and Erection of a Plate-girder Bridge over the River Lee, at Broxbourne: L. W. Atcherley.

MONDAY, DECEMBER 7.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Cellulose and Chemical Industry: C. F. Cross and E. J. Bevan.

ROYAL SOCIETY OF ARTS, at 8.—Twenty Years' Progress in Explosives: Oscar Guttmann.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Danish North-east Greenland Expedition: Lieut. A. Trollé.

VICTORIA INSTITUTE, at 4.30.—Geneva and Chamounix of To-day as compared with half-a-century ago: Prof. Edward Hull, F.R.S.

TUESDAY, DECEMBER 8.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Notes on Early Ornament: Dr. C. H. Read.—The Lushai-Kuki Clans: Lt.-Col. J. Shakespear.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Rotherhithe Tunnel: E. H. Tabor.

WEDNESDAY, DECEMBER 9.

ROYAL SOCIETY OF ARTS, at 8.—Kinematography in Natural Colours: G. Albert Smith and Charles Urban.

THURSDAY, DECEMBER 10.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On Reciprocal Innervation of Antagonistic Muscles. XIIth Note: Proprioceptive Reflexes. XIIIth Note: On the Antagonism between Reflex Inhibition and Reflex Excitation: Prof. C. S. Sherrington, F.R.S.—Electrolytes and Colloids. The Physical State of Gluten: Prof. T. B. Wood and W. B. Hardy, F.R.S.—On the Specific Heats of Air and CO at Atmospheric Pressure by the Continuous Electric Method at 20° and 100° C.: W. F. G. Swann.—Potential Gradient in Glow Discharges from a Point to a Plane: J. W. Bispham.—The Extension of Cracks in an Isotropic Material: A. Mallock, F.R.S.—Results of Magnetic Observations at Stations on the Coasts of the British Isles, 1907: Commander L. Chetwynd, R.N.—The Rotation of the Electric Arc in a Radial Magnetic Field: J. Nicol.—On Anomalies in the Intensity in Diffracted Spectra: H. C. Pocklington, F.R.S.—The Isothermal Layer of the Atmosphere and Atmospheric Radiation: E. Gold.—Contribution to the Osmotic Theory of Solution: The Earl of Berkeley, F.R.S., and C. V. Burton.—A Comparison of the Radium Emanation Spectra obtained by Different Observers: T. Royds.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8 (*Ordinary General Meeting*).—Output and Economy Limits of Dynamo Electric Machinery: J. C. Macfarlane and H. Burge.—*Probable Paper*: Commercial Electric Heating: J. Roberts.

ROYAL SOCIETY OF ARTS, at 4.30.—The Birds of India: Douglas Dewar.

MATHEMATICAL SOCIETY, at 5.30.—On the Propagation of Sound Waves Vertically in the Atmosphere: Prof. H. Lamb.—(1) On Sir William Rowan Hamilton's Fluctuating Functions; (2) On the Representation of a Function by Series of Bessel's Functions: Dr. E. W. Hobson.—Theory of Cauchy's Principal Values (Fourth Paper): G. H. Hardy.—Solution of a Problem of Mersenne's: Dr. T. Stuart.—Note on a Continued Fraction Equivalent to the Remainder after *n* Terms of Taylor's Series: Prof. L. J. Rogers.—Solid Angles and Potentials of Plane Discs: Balak Ram.

FRIDAY, DECEMBER 11.

PHYSICAL SOCIETY, at 8.

MALACOLOGICAL SOCIETY, at 8.—On *Carelia pilsbryi*, n.sp.: E. R. Sykes.—The Radulæ of British Helicids, Pt. II.: Rev. E. W. Bowell.—New Species of Plectopylis: G. K. Gude.—A Preliminary List of Recent Middlesex Mollusca: J. E. Cowper and A. Loydell.—The Application of the Names Gomphina, Marcia, Hemitapes and Katelysia: A. J. Jukes-Browne.

CONTENTS.

THURSDAY, DECEMBER 10, 1908.

BIOLOGICAL RESEARCH ON THE LANCASHIRE COAST.

Report for 1907 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Sea-Fish Hatchery at Piel. Drawn up by Prof. W. A. Herdman, F.R.S., assisted by Mr. Andrew Scott and Mr. James Johnstone. No. xvi. Pp. 406; with illustrations. (Liverpool, 1908.)

ABOUT half the bulk of this report is devoted to a monograph on the edible crab by Mr. Joseph Pearson. Excellent features of this work, which is illustrated with twelve plates and numerous diagrams in the text, are the methodical arrangement of the matter and the clearness and simplification of the descriptions. Hitherto, students who aspired to more than a general knowledge of the anatomy and development of the crab have had to search out and abstract for themselves the numerous original memoirs scattered in various scientific journals in different languages, a labour which only specialists care to undertake. It is, therefore, extremely useful to have all these researches carefully epitomised and brought together in one volume. Again, although the general features of the anatomy and development are fairly well known to readers of text-books, the average student knows very little about the habits of the crab, partly because the literature of this part of the subject is mainly of recent growth, and partly because the original memoirs dealing with it are contained in reports which have a somewhat limited circulation. Accordingly, much of the information contained in the section of this work which deals with "Bionomics," namely, such matters as the migrations, spawning habits, rate of growth, age and size at maturity, frequency of casting, "autotomy" and limb-regeneration, &c., will be new to those readers who have not consulted the more recent annual reports of the Fishery Board for Scotland and other journals. Altogether, Mr. Pearson's monograph maintains the high standard of excellence characteristic of the series of "L.M.B.C. memoirs" of which it is the latest number. This series of monographs can only be described as a boon both to general students and specialists.

A voluminous and important contribution to this report is given by Prof. Herdman, assisted by Mr. Andrew Scott, under the title of "An Intensive Study of the Plankton around the South End of the Isle of Man." The thorough nature of this investigation may be gathered when it is stated that the numbers of every species of organism obtained in more than 800 separate gatherings of plankton were carefully estimated—a vast labour in itself. More than 600 of these samples were collected within a very restricted area in the neighbourhood of Port Erin, simultaneous hauls being made with various kinds of pelagic nets both of the horizontal (tow-net) and vertical type, and these were worked in different depths of water. These samples were collected every week and almost every day during a full yearly period.

One feels justified in accepting with confidence conclusions which are based on observations the frequency of which in time and space is so great. On this secure basis Prof. Herdman discusses the seasonal changes in the abundance of plankton as a whole and of its various constituents, and arrives at important general conclusions regarding its vertical and horizontal distribution. Thus, it has been found, here as elsewhere, that diatoms reach their maximum development in April, and rise again to a second but less important and less constant maximum in autumn; dinoflagellates rise to a maximum later than the diatoms, and have also a sudden periodic increase in autumn; copepods attain their maximum in early summer after the diatoms have died down, and again in late autumn they follow the phytoplankton. The distribution of particular species is also exhaustively discussed and illustrated by means of frequency curves. Of more general interest is the evidence that the zone of most abundant life is not at the surface, but is generally a few fathoms below. This observation is of decided importance in connection with the depth at which certain plankton-feeding fishes such as the mackerel and herring swim. As regards the horizontal distribution, it is found that while some organisms have a very regular and uniform distribution over a considerable area, others are distributed very unevenly, including those which markedly tend to congregate in shoals.

"The horizontal distribution is consequently liable to be very variable and irregular, and although its characteristic constitution at different times of the year may be described, it is very doubtful whether any numerical estimate can be framed which will be applicable to wide areas."

This conclusion appears rather to discount the efforts of certain German naturalists to arrive at a census of pelagic organisms in whole seas on the basis of the numbers caught in hauls with specially designed quantitative apparatus.

Considerable light on the movements of plaice, and on the intensity with which the fishing for this species is carried on on the Lancashire and Welsh coasts, is thrown by the results of marking experiments reported on by Mr. James Johnstone and illustrated by means of two charts. These experiments bring to light a marked tendency on the part of small plaice to leave the estuaries and bays of this coast and move seawards in the summer months. The older fishes apparently leave the district for good. Some of these were found to have crossed the Irish Sea, while others had entered the Firth of Clyde. From 25 to 30 per cent. of the fishes liberated were returned by fishermen, but Mr. Johnstone has good reasons for believing that many more are re-captured than are returned. This represents a considerable intensity of fishing in the eastern part of the Irish Sea, and it is further interesting to note that by far the greatest numbers of marked plaice were recaught by first-class sailing trawlers. There is still, however, a good deal of obscurity as to the exact direction of the movements of the plaice in this district

at different stages of their lives. Further experiments with much larger batches of fishes will be required in order to provide material for the construction of a complete and convincing picture of these movements. In future experiments it would be desirable to determine the sex and maturity as well as the size of the fishes liberated, in order to discover whether there is any difference in the migrations of the two sexes, and to distinguish spawning migrations from feeding migrations.

From time to time, over a period of fifteen years, but, unfortunately, not with any regularity, experimental hauls have been made by the Lancashire authorities with shrimp-net, shank-net, and fish-trawl both on the Blackpool closed ground and in the Mersey estuary. The numbers of flat fishes and shrimps caught in these hauls form the basis of two short but valuable papers by Mr. Buchanan-Wollaston. The method adopted in this research is that of reducing the catches to the average number caught per hour in different months, quarters, and years, and then expressing the results in the form of frequency curves. The curves for the monthly data were too irregular to show any general tendency, but by taking the averages for certain combinations of months and for different years, and "smoothing" the curves thus produced, certain interesting features are brought to light. Thus it is clearly seen that on the Blackpool closed ground there has been a steady falling off in the catch per hour of plaice since 1892. No explanation is offered of this remarkable phenomenon, which, one supposes, must be due to the increased intensity of fishing on the offshore grounds. It is also shown that the "shank-net" is "superior to the shrimp-trawl in avoiding the capture of young fish, and this with no loss or even a small gain in the capture of shrimps."

In the Mersey estuary, plaice and soles reach their maximum abundance in late summer and autumn, but it is doubtful whether the data are sufficiently complete to justify the conclusion that soles attain their maximum in August and plaice in September. Finally, an examination of the (smoothed) curves showing the average catch per hour of plaice and soles on the Mersey banks shows some remarkable fluctuations, those of the two species being complementary, so that in those years when plaice were least abundant, soles attained their maximum. The importance of such researches as these from the point of view of the local fisheries scarcely requires to be emphasised.

In addition to these papers, Dr. H. Bassett contributes one on hydrographic observations, and Mr. Johnstone one on fish parasites.

As regards the work of the Piel hatchery, while it is questionable whether any demonstrably useful purpose is being served by annually "dumping" in the Irish Sea millions of newly-hatched fry of plaice and flounder, it seems not improbable that the holding of classes for fishermen is as effective in practice as it is excellent in theory.

It will thus be seen that the work which these two institutions are vigorously carrying on in the interests of marine biology in general, and the local fisheries in particular, is of a comprehensive and many-sided character. The expenses of this work appear to be met by funds derived from several distinct sources. For example, the cost of holding classes for fishermen at Piel is defrayed by a grant from the education committee of the Lancashire County Council, while Mr. Pearson's work on the crab was done and published, we are told, under the auspices of the Lancashire Sea Fisheries Committee, with the aid of grants from the Board of Agriculture and Fisheries, the University of Liverpool, and the Liverpool Marine Biology Committee. This appears to be a somewhat complicated arrangement, which perhaps, however, has the advantage of the safety which is popularly supposed to reside in numbers. It shows, at any rate, that marine biology in Lancashire does not lack friends.

W. W.

LABORATORY ARTS.

Laboratory Arts. A Teacher's Handbook dealing with Materials and Tools used in the Construction, Adjustment, and Repair of Scientific Instruments. By Dr. George H. Woollatt. Pp. xii+192; with 119 diagrams. (London: Longmans, Green and Co., 1908.) Price 3*s.* 6*d.* net.

SKILL and wide knowledge in "laboratory arts" are much rarer attainments than the accumulation of ideas relating to abstract or even to mathematical physics, yet, without making comparisons, it is essential to the success of the experimentalist. If it were not for the fact that such skill and knowledge are not to be acquired by mere reading of a few books, it might be thought that the disproportion alluded to above might be the result of the still more marked disproportion between books of the text-book type dealing with the two branches of attainment. Actually, it is probably the cause, or partly so, and it may be also that the scarcity of books such as that now being noticed is due to a belief on the part of the few qualified to write them that, dealing as they do with a subject which directly is not an examination subject, there will be no great demand for them. Whatever the cause may be of the scarcity of books dealing with laboratory arts, they are actually invaluable, and from Faraday's chemical manipulation onwards they furnish the experimentalist with ideas as to how to accomplish his purpose.

Dealing as such books must do with all the properties of all materials and with the means peculiar to each whereby they may best be cut, distorted, attached, or protected, it is not possible for any one writer to be equally strong in all parts. A writer is certain to be specially strong in certain departments; let it be so; those who are or might be his fellow-writers of similar books will be quick to recognise these parts, and to benefit by them. Conversely, of course, no one book is likely to be quite satisfactory in dealing with every kind of operation where they are so diverse. Leaving now generalities and coming to the "Laboratory Arts" as presented by Mr. Woollatt, we find an admirable choice of material admirably presented. It must be understood that the teacher or the experimentalist probably is not and may not

even want to be accomplished in the art of using tools and producing results in the conventional way as performed in the way of trade by the professional. In the opinion of the writer of this notice, he ought not to want, for in that case he is certain to sacrifice his interest in the object for which he is preparing something to the preparation itself; he will change from the experimentalist to the amateur mechanic. He must, if he will retain his *rôle* as experimentalist, learn to be ruthless, and, if necessary, to do brutal things and defy every convention, so long as he attains his object. The author expresses this idea more neatly as follows :—

"The craftsman will doubtless find humour in some of the suggestions put forward herein, but it should be remembered that we are first of all teachers, and that we must use skill in craftiness in order to overcome our lack of the craftsman's skill. These are methods that will serve our purpose, and they are within our resources."

Was not the same idea expressed by the great Fresnel nearly a century ago in words such as these :—"If you cannot file with a saw or saw with a file you will be no good as an experimentalist"?

Wood-work, metal-work, and glass-work are the subjects of the first three divisions of the book, and these are supplemented by one called general, in which sixteen diverse subjects are treated, and these are followed by three appendices and an index. It would be tedious, and it would serve no useful purpose, to go through these chapters seriatim. It is sufficient to say that the descriptions are clear and are well illustrated, and that the book will be a valuable if not an invaluable addition to the working library of every physical laboratory. While commendation is justly earned by the author, there are a few points to which the writer would direct his attention in the hope that they may assist him in the preparation of the second edition.

In the section dealing with grinding and sharpening, the use of emery or carborundum wheels for grinding, or of artificial hones made of these materials for sharpening, is not suggested. The writer would urge that the natural stones have been superseded; he would be glad to know the experience of others with a slab of aluminium as a hone for the production of a fine edge. A solution of camphor in terpentine is, as is usual, recommended for use when drilling glass. The writer has always wondered what the camphor is for and if it makes any difference, for a recipe of this kind is and always will be faithfully repeated in book after book even when useless. Camphor dissolved in turpentine is used in making certain tailed stars for rockets. Did a firework-maker once lubricate a drill with the only turpentine he could find and thus start the use of camphor? Prof. Threlfall is most enlightening on the subject of drilling glass in his book on laboratory arts.

It is an omission to describe methods of cleaning mercury and ignore the existence of the vacuum still, which ought, in the writer's opinion, to be set up permanently in every physical laboratory. Similarly, it is an omission to describe a number of well-known cements and ignore the existence of that most useful addition to the resources of the experimentalist, viz. the much advertised cæmentium. The writer has used this material on all classes of substances, and he considers it one of the most useful in the laboratory. He would mention incidentally that it does not ruck up the end grain of soft wood, so that badly made patterns may be quickly smoothed over with it and interior angles filled in without producing a hedgehog back, as is the case with shellac varnish, and giving rise to the necessity for much glass-papering. Soldering is described as practised with the tinman's "bit." This, it is true, is often, especially with sheet work, exceedingly useful, but for nearly all the operations of the laboratory, especially when thicker work in brass is to be put together, the method known as sweating is preferred, and will be practised nine times while the bit is used once. The process of sweating is not described, nor is there given the very important direction to wash well and, if possible, to boil everything that has been soldered or sweated with chloride of zinc. Silver soldering is the cleanest and neatest form of brazing, and it is surprising that it is not more commonly practised. The author's description appears to the writer somewhat meagre. The essential to success being a uniform low red heat, the process is much more easily carried on in a fire bed or in a muffle than by a more fierce and local source of heat such as a blowpipe. Where this is used, every use that is possible should be made of reverberation from pieces of firebrick to maintain the heat uniform.

The author rather lets himself go when he gets to varnishing, staining, French polishing, and sand-papering. Information of the kind is very useful in its way, but if there is anything in which the student should not be encouraged it is on the "beautification" of his apparatus. Varnish or paint for preservation are well enough when there is necessity to preserve; as a rule, experimentalists' apparatus is made, used, and done with; it requires neither beautification nor preservation. The results obtained may be worth the latter.

We would, in concluding this notice, refer to two passages in the preface :—

"The ability to 'fix up' a piece of uncatalogued apparatus, by which a point under discussion may be proved, is worth the expenditure of time and trouble in its attainment, but until now no systematic attempt has been made in this direction, and it is only through the organisation of summer courses for science teachers in Ireland and Yorkshire that the prospect of success is held out."

And again :—

"The result must be a quickening of interest on the part of teachers able for the first time to construct their own special apparatus."

Has the author ever heard of the late Dr. Guthrie, who instituted this identical work at South Kensington, and sent out into the country hundreds of science teachers armed, it is true, with imperfect craftsmanship, but for all that able to "fix up" simple

apparatus with simple means? Dr. Guthrie's successors have not neglected the study of laboratory arts either, and anyone who has been connected with South Kensington must resent the suggestion that the desideratum here set forth is now capable of attainment for the first time. C. V. BOYS.

MORAL EDUCATION.

(1) *Moral Instruction and Training in Schools.* Report of an International Inquiry. 2 vols. Edited by Prof. M. E. Sadler. Vol. i., pp. lviii+538; vol. ii., pp. xxviii+378. (London: Longmans, Green and Co., 1908.) Price 5*s*. net each.

(2) *Papers on Moral Education communicated to the First International Moral Education Congress.* (London: David Nutt, 1908.) Price 5*s*.

THE recent congress on moral education and the volumes which contain the results of the international inquiry upon the subject have rendered at least one great service to current educational thought. They have given us, on the one hand, a large amount of information on what is being done in various parts of the world in the matter of moral instruction and training, and, on the other hand, a series of valuable essays upon the various aspects of the problem as it presents itself to responsible persons, by means of which it is possible to examine some of the fundamental issues which are raised.

As Prof. Sadler frankly admits in his admirable preface to the committee's report, there is much variety of opinion expressed in its pages, and we may note at once that each of these many opinions is based upon experience. They furnish another illustration of the fact that successful experience is not always a safe guide in reaching scientific conclusions. Successful experience may even darken counsel! Witness the experience of those races who succeed in driving away the evil spirits who are attempting to destroy the light of the moon during an eclipse. In important matters of practice we are naturally eager to arrive at a guiding principle, and interest centres in the successes of this or that method. In our impatience to act, we do not wait to consider the failures, and we have no time to give to the wearisome analysis which aims at laying bare the elements that condition success and failure alike. Nevertheless, it remains a fact that, until this has been done, all procedure, even successful procedure, is little more than groping in the dark.

Such general agreement as is revealed in these volumes would perhaps be represented by a rather empty formula defining the aim of moral education, shall we say? to lead the individual to accept some principle which will give unity and meaning to his life. So soon as we step outside this or some similar statement, differences of a two-fold character are revealed. In the first place, we find them in the answers to the question, What is to be the nature of this unifying principle? "Service," says Mr. Gould; "the freedom of the inner life," says Prof. Foerster; whilst Dr. Penzig refuses teleological considerations any place in moral instruction, and others, again, would find the unifying principle in the conception of the active interest and supervision of a Divine Personality; and in the next place we find them when we inquire about the method to be followed in the effort to lead pupils to this principle. Here the differences are in part consequential upon the individual attitude to the previous question. It will make a world of difference, for example, whether the definitely religious point of view is accepted or not. But, leaving that particular difficulty aside, there remains the conflict between the advocates of the direct and systematic treatment of morals and those who favour indirect and incidental teaching. Both parties to the conflict admit the fundamental importance of training, of habit formation, but the former would have, in addition, definite lessons in the "oughts" of life, drawn from the consideration of concrete illustrations of virtuous and of foolish action, as told in story by the teacher. The point of view is precisely that of the teacher who wishes to establish a scientific law. The pupil is led to derive the law from the comparison of carefully chosen concrete examples. At a later stage various generalisations may be reviewed and compared with the view of arriving at a still more general principle, until finally the most widely embracing uniformities are conceived and formulated as "laws of nature."

This attitude towards the problem appears to rest on two assumptions. It seems to place moral law and physical law in the same category, and it seems to take for granted the child's capacity to analyse conduct and motive in the objective manner of some adults. It is not necessary to insist at length upon the difference between an ethical principle and a scientific generalisation. The ethical principle is a matter of personal adoption; it has a psychology and a meaning which differ fundamentally from the intellectual apprehension of a uniformity in the phenomenal world. There can be no analogy between the two such as would justify the statement that "the relation between indirect and direct moral instruction is the same as that between nature-study and science." The point is touched, though somewhat slightly, by M. Gabriel Séailles in a thoughtful paper read to the conference. Incidentally he also puts his finger upon the errors in psychology which not infrequently underlie the advocacy of the systematic treatment of the subject.

It is said, for example, that the children of poor districts are face to face with problems of gambling, intemperance, &c., and the school should come to their rescue by teaching them the wickedness of all these things that make up the daily life of their parents. As to the problems in the midst of which such children are said to find themselves, are the facts of their environment in any sense problems for the children? The lad who plays pitch and toss finds his problem in the effort to escape the vigilance of the policeman. A problem implies a contradiction felt in the actual experience of the individual. A contradiction between what the teacher says and the dominating facts of an out-of-school life will cause no more difficulty than the mathematical treatment of a space of four dimensions will affect my attitude to the facts

of my spatial environment. As M. Séailles puts it, the experience of the children of the poor may often be such that moral instruction will seem like fairy-tales, only not nearly so amusing. Where there is antagonism between life and the school, the handicap is heavily against the school, and we may doubt whether the weight of words will improve the chances of success.

What of the child in happier circumstances? Is not the teacher's moral analysis likely to be viewed as a rather futile attempt to find excuses for the obvious? Is there any more reason for the child why we should demonstrate the inherent evil in this or that course of conduct, or why we should trouble ourselves to urge the good upon him as superior to the evil, than that we should give him reasons for calling an orange yellow and not black?

The whole question of the attitude of the child to moral instruction has received relatively little scientific consideration. It is not easy to get at the facts. Mere reminiscence can never satisfactorily reveal them. We need some objective methods of inquiry such as have already been foreshadowed in the pedagogical experiments of Meumann and others. The development of purposefulness in action, the study of the working of contrariant ideas, the determination of types, the analysis of cases of moral degeneracy, may all in their turn help to raise the discussion of moral education to something more nearly approaching a scientific level.

The most striking cases of successful methods seem at present to come from the institutions engaged in the education of moral degenerates. The results of the reformatory and industrial school system offer striking testimony to the soundness of Prof. James's reply when asked what he would do to make education of greater ethical effect:—"Increase enormously the amount of manual training relatively to the book work."

J. A. GREEN.

CLIMATE.

Climate, considered especially in Relation to Man. By Prof. Robert de Courcy Ward. Pp. xv+372. (London: John Murray, 1908.) Price 6s. net.

PROF. WARD explains in the preface to his book that its aim is "to coordinate and to set forth clearly and systematically the broader facts of climate in such a way that . . . the general reader, although not trained in 'the technicalities of the science,' may find it easy to appreciate them," while "the needs of the teacher and student have been kept constantly in mind." An introductory chapter, essentially a synopsis of the first six chapters of vol. i. of Hann's "Klimatologie," gives an outline of the climatic elements and of solar and physical climate. The classification of climates according to belts of latitude and the general distribution of land and sea is next dealt with, and to this section is added a brief account of some of the more elaborate subdivisions which have been proposed. Then follow sections on the characteristics of climate in the tropics, the temperate zones, and the polar zones; on the hygiene of the zones, and on the life of man in the zones; and a final chapter on changes of climate.

The basis of classification of climates actually adopted by the author, and employed in the second or applied section of his treatise, is thus primarily that of tropical, temperate, and polar zones, with boundaries defined by wind systems rather than by parallels of latitude or isothermal lines. Each zone is then subdivided according to the distribution of land and sea, giving as types marine, windward, and leeward coastal climates, interior climates, and, as a separate group, mountain climates. Experience has shown that, for general purposes, and particularly for elementary teaching, this method, in one form or another, is by far the most satisfactory, and it seems somewhat unfortunate that Prof. Ward does not state his own position more clearly and fully in his introductory chapters. The more elaborate methods, the description of which is here necessarily so condensed as to make difficult reading, are admittedly unsuitable for the purposes of the later sections of the book, and practically no use is made of them, but Prof. Ward deals with the method he himself employs in a couple of pages, and we are left in some uncertainty concerning his own views.

The descriptions given of the characteristics of the main climatic regions are admirable, and Prof. Ward has brought together an immense amount of illustrative matter which has hitherto been inaccessible to the ordinary reader. We could have wished, however, to see greater definiteness given to the normal position and extent of the major zones and their migrations by the insertion of a table similar to that given by Prof. Davis in his "Elementary Meteorology," showing the position of the equatorial belt and the trade wind belts at different seasons. Such a statement would, by the way, have made it easy to deal more adequately with the important question of the geographical and seasonal distribution of tropical cyclones. The distribution of monsoon regions seems also scarcely to receive the treatment it deserves; monsoon "belts" are discussed under the heading of tropical climates, the extension of monsoons in north-eastern Asia being merely referred to as an exception. The profound influence of the relief of the land in the production of monsoons and land and sea breezes is not emphasised, nor, in our opinion, is the importance of what may be termed "monsoonal influence" sufficiently recognised.

In the chapters describing the mode of life and occupations of mankind in different climates, Prof. Ward has again collected a wealth of illustration which affords extremely interesting reading, and will be of great value to the teacher. A good deal of matter, especially where the complex conditions of civilised life in the temperate zones are concerned, refers more to general geography than to climatology pure and simple, and considerable discussion might arise on the question of the precise significance of the climatic element in certain cases, but, on the whole, Prof. Ward avoids the dangerous pitfalls which beset this subject with great skill.

SCHOOL ARITHMETICS.

(1) *A School Arithmetic.* With Answers. By H. S. Hall and F. H. Stevens. Pp. xiii+475+xxxix. (London: Macmillan and Co., Ltd., 1908.) Price with answers, 4*s.* 6*d.*, without answers, 3*s.* 6*d.*

(2) *A Modern Arithmetic, with Graphic and Practical Exercises.* By H. Sydney Jones. Pp. xiv+598. (London: Macmillan and Co., Ltd., 1908.) Price, with or without answers, 4*s.* 6*d.*

(3) *Advanced Arithmetic and Elementary Algebra and Mensuration.* A Text-book for Secondary Schools and Students preparing for Public Examinations. By P. Goyen. Pp. xii+435. (London: Macmillan and Co., Ltd., 1908.) Price 3*s.* 6*d.*

(4) *Elementary Mensuration.* By W. M. Baker and A. A. Bourne. Pp. vi+144. (London: George Bell and Sons, 1908.) Price 1*s.* 6*d.*

(5) *Practical Arithmetic and Mensuration.* By Frank Castle. Pp. viii+249. (London: Macmillan and Co., Ltd., 1908.) Price 2*s.*

THE widespread attention that has been given during the last decade to the study of elementary mathematics has had a most salutary effect on the teaching of arithmetic, as is evidenced by the improved text-books that are now available and illustrated by the five books under review. The claims of science, the laboratory, and the workshop are coming to be adequately recognised, and commercial arithmetic is not allowed unduly to dominate the course. Moreover, some amount of experimental and quantitative work is done in connection with the subject, and associated more or less closely with decimal measurements, mensuration, approximate methods of computation, and perhaps with the use of tables of logarithms and even of sines and cosines. Again, algebraical notions and graphical processes are naturally and inevitably much in evidence. Altogether the treatment is on broader lines, the examples are drawn from a wider region, and are in much closer contact with common every-day experiences.

(1) The book by Messrs. Hall and Stevens fully realises the high expectations with which it has been awaited, and will immediately rank as one of the best text-books on the subject. Every modern development of value is embodied in its pages, and the whole is arranged with the thoroughness and skill which is always a feature of any work undertaken by the experienced authors. The book is divided into two parts, which may be obtained either separately or together, and with or without answers. The first part gives the fundamental principles and processes with which every youth should become familiar, very special attention being given to orderly arrangement of work and the cultivation of habits of rapid and accurate computation. The second part is somewhat more technical, and allows opportunity for discrimination according to the class of pupil. Where all is so good it is unnecessary to particularise. The explanations and proofs are always sufficient, clear, and concise; the well graduated examples are abundant, and range over a wide field of interest; the production of the book is a fine example of the printer's art; and from every point of view this arithmetic is of almost unrivalled excellence, and must soon be widely used in our schools.

(2) The title chosen by Mr. Jones for his book is most appropriate, for as regards originality of treatment and as leading the way in the reform this arithmetic is second to none, while at the same time the whole ground is covered in a thoroughly efficient manner. The author exhibits a charming faculty for selecting examples from new and unexplored sources, thereby adding greatly to the interest and diversity of the work. Variety is otherwise obtained by arranging the sets of exercises respectively as oral, mental, graphic, practical, general, revision exercises, and typical examination papers. The graphical and practical examples, comprising drawing, measuring, weighing, &c., using simple apparatus, are especially valuable, forming a systematic and most desirable course in quantitative experimental work. The chapter on logarithms includes the use of the slide-rule. The chapters on mensuration, statistics and averages, stocks, shares, and bills of exchange are particularly good. Teachers will find part i. of the book sufficient for the Oxford and Cambridge local and similar examinations in arithmetic, and this, with part ii., will meet all the requirements of other examinations such as those of the Army and the Civil Service. The general get-up of the book is most attractive. Teachers and students alike will welcome this notable arithmetic, and it should be extensively adopted.

(3) The author of this work is an inspector of schools in New Zealand, and its appearance is an indication that our colonies are in touch with modern developments in the teaching of elementary mathematics. The book proceeds on lines very similar to those just noticed; algebraical symbols are in continuous use from the start; the algebra extends to quadratic equations and the progressions, and the mensuration is carried as far as problems on the simpler geometrical solids. The subject is well presented and is quite up to date, and the student is provided with a large number of good and varied examples.

(4) The major portion of this book, including a chapter on contracted arithmetic, deals with the properties, construction, and mensuration of plane figures, with an application to surveying. The later chapters relate to the simple geometrical solids and the annulus. Proofs of the formulæ are given, though those for the surface and volume of an annulus are not altogether convincing. The general treatment is very elementary and simple; it does not include any mention of the prismoidal formulæ. Many sets of examples and revision papers are provided, the answers being collected at the end of the volume.

(5) The "Practical Arithmetic" by Mr. Castle is primarily intended for students of technical classes and evening schools, where, in making actual measurements in the laboratory, the pupil sees the necessity for and becomes acquainted with the more important arithmetical processes, including approximations and contracted methods. Thus theoretical study is subordinated to practical work, and the knowledge of principles is acquired largely

through the medium of the latter. Aids to computation, such as logarithms and the slide-rule, are introduced and largely employed in the later stages. Trigonometrical tables are also explained. The principal feature of the work is perhaps the excellent and extensive collection of practical exercises, in which the student has the advantage of the author's expert knowledge of the building and engineering trades and of his wide experience as a teacher. The subject is developed in the modern spirit, and the book will be very acceptable in many quarters.

GERMAN PHILOSOPHICAL TEXT-BOOKS.

Geschichte der Philosophie. By Karl Vorländer. I. Band, pp. xiv+361; II. Band, pp. viii+512. (Leipzig: Dürr'schen Buchhandlung, 1908.) Price 3.60 marks and 4.50 marks.

Grundlinien der Psychologie. By Dr. Stephan Witasek. Pp. viii+392. (Leipzig: Dürr'schen Buchhandlung, 1908.) Price 3 marks.

Die Entstehung der wirtschaftlichen Arbeit. By Dr. Ed. Hahn. Pp. iv+109. (Heidelberg: Carl Winters Universitäts-buchhandlung, 1908.) Price 2.50 marks.

PROF. VORLÄNDER'S "Geschichte der Philosophie" is an attempt to compress into two small volumes an account of the course of development of philosophy from the earliest times to the present day. When it is added that the work includes a short account of the life and writings of almost every writer of any importance at all in philosophy during the last five-and-twenty centuries, little hope will be felt of the success of the author in his attempt. It is therefore of the highest credit to Prof. Vorländer that he has achieved the seeming impossible, and produced a work which is both eminently readable and strictly accurate. He displays complete mastery of his subject throughout, and a fine sense of the distinction between the relevant and the irrelevant, the latter quality being possibly in part due to the fact that he is a prominent representative of the Neo-Kantian school, and excels in the application of the critical method. The same fact explains why so large a portion of the second volume is allotted to a treatment of the philosophy of Kant, at the expense chiefly of the description of Hegelianism which follows, and which cannot but be considered extremely inadequate by any school of philosophers. The last hundred pages of the book, on the philosophy of the present day (since 1840), make very interesting reading, and give much information not to be found outside the pages of "Ueberweg-Heinze"; but where so many names are mentioned, it is surely most surprising to find no reference whatever to William James and the pragmatic school, more particularly as the prodigious development of the science of psychology during the last few years and its significance for modern philosophy are distinctly emphasised.

Of late years text-books in psychology have been multiplying rapidly, but no external justification is needed for the publication of Dr. Stephan Witasek's manual. This book is admirably arranged, clearly written, and thoroughly up to date, and is probably the best and most complete *introductory* text-book of the science which we possess at the present day. In the earlier, more general, chapters the author argues out controversial points thoroughly, yet without profuseness; in the later ones, on "special" psychology, he gives the very latest results in the experimental study of the different forms of mental process. The discussion of the various possible theories of the relation of mind and brain is exceptionally well done. The arguments against psychophysical parallelism and its most recent form, panpsychism, are effectively put, and although the author admits that there are also serious objections to the interaction theory, it is very evident that his own sympathies are in this direction. The outcome of the discussion would seem to be, "Either interaction or a substantial soul," which, if quaint, is decidedly optimistic!

Dr. Hahn's book is a short anthropological essay on the origin of work possessing little more than an academical interest. WILLIAM BROWN.

OUR BOOK SHELF.

The Radio-active Substances. By W. Makower. Pp. xii+301. (London: Kegan Paul and Co., Ltd., 1908.) Price 5s.

THE author's aim in writing this volume is to present the chief phenomena and theories relating to radioactivity in a concise and simple form. The subject has been competently dealt with in an elementary manner in other works, but it is advancing rapidly, and the present work is intended to enable readers to keep pace with its development. All branches of the subject are treated in this book. Beginning with chapters on the nature of gaseous conductivity and on the methods of measurement employed, the author goes on to describe the discovery of the radio-active substances, the nature of the radiations they emit, the emanations, the active deposits from the emanations, and their successive transformations. In the concluding chapters the activity of substances in general and the mechanism of radioactive changes are briefly discussed.

The author has succeeded admirably in his aim of giving a very full and accurate summary of the chief facts and theories in a concise form, but perhaps the summary is too complete and condensed for general readers. The food supplied is sound and wholesome, but the general reader who has no knowledge of the subject to start with will find it difficult to absorb all the nourishment supplied to him in such condensed form. In some parts, notably when discussing the successive transformations of the radium atom, the author has successfully made use of simple analogies in presenting the results to his readers.

In the introduction the author is guilty of stating that the properties of radio-active substances have necessitated a "revision of many of our conceptions both in physics and chemistry." In no sense is this statement defensible, and occurring in a book intended in some measure for non-scientific readers, who are too prone to consider every new discovery as upsetting previous conceptions, it is likely to lead to the aggravation of an evil already sufficiently pronounced. It is due to the author, however, to point out at once that the above statement is an isolated one, and that the book as a whole conveys no such impression, showing as it does how the conceptions evolved from the study of radio-activity follow as a natural sequence

those ideas already existing in the minds of physicists before the discovery of the first of the radio-active substances.

In summarising work on points about which there is difference of opinion the author shows a commendable caution, and his verdict usually appeals to one as safe; perhaps an exception occurs where he states that the available evidence indicates that the activity of radium C can be altered by change of temperature.

The book constitutes a valuable addition to the literature of radio-activity, and can be recommended to those interested in that fascinating subject.

J. A. M.

The Psychology and Training of the Horse. By Count E. M. Cesaresco. Pp. xvi+334. (London: T. Fisher Unwin, 1906.) Price 10s. 6d. net.

In spite of its title, this book is no addition to our rapidly multiplying collection of works on animal psychology. It cannot be called scientific in the strictest sense. Modern psychological science endeavours so far as possible to found its conclusions on experimental treatment of its subject-matter, and in the case of the lower animals, where direct introspection is impossible and analogy unsafe, it refuses to accept conclusions not obtained in this way. But no records of experiments performed on the horse are to be found in Count Cesaresco's book. Description and anecdote there is in plenty, and that of the greatest interest, but all explanation is *a priori* and decidedly anthropomorphic. Psychological terms are used wherever possible to give precision to a description the main value of which is independent of such adventitious adornments. Not that the psychology is necessarily incorrect; on the contrary, it appears to have probability on its side, only it cannot lay claim to the title of strict science.

The practical knowledge displayed by the author is full and precise, and, doubtless, will alone suffice to commend the book to horse-lovers. Indeed, the earlier "psychological" chapters on the nature of the horse's mind form a description written merely *ad hoc*, prefatory to the main theme of the book, viz. the best methods that may be employed in the training of the horse for the service of man. These methods are based on the assumption that the horse learns by association of his actions with their pleasurable or painful effects, and by no higher process. No record is given of any attempt to justify this assumption experimentally. At times the book barely rises above platitude, and there is also much unnecessary repetition strewn up and down its pages. The absence of any of the elegances of style is doubtless to be accounted for by the fact that the author is writing in a language not his own. Despite these drawbacks, the book is quite readable, and thoroughly justifies its existence.

Elementary Botany. By Dr. E. Drabble. Pp. vi+234. (London: Edward Arnold, n.d.) Price 2s. 6d.
Biologie unserer einheimischen Phanerogamen. By M. Wagner. Pp. xii+190. (Leipzig and Berlin: B. G. Teubner, 1908.) Price 6 marks.

It would seem almost impossible to devise a new disposition of matter in an elementary text-book, but it must be allowed that Dr. Drabble has drafted a setting which differs in arrangement from the standard books of its kind. He begins with an explanation of physiological principles as a preparation for the interpretation of morphological structure, and touches on plant modifications and classification. The course outlined is very workable, and will certainly find favour with not a few teachers in schools. The text is characterised by accurate and logical exposition, combined with a sufficiency of illustration to make the points clear. Experiments for testing the physiological deductions are suggested. These might in several instances have been more fully detailed with advantage. The figures are not so creditable, and some are unnecessarily crude, such as the crocus corms and the fruits on p. 165, while Fig. 8 supplies an example of how not to set up the experiment. These are, however, slight defects when compared with the general excellence of the subject-matter.

The botanical volume, written by Dr. M. Wagner, is in no sense a text-book for use in schools, but provides a compendium of the various contrivances, mechanisms, and characteristics of flowering plants. Thus, in a chapter on light requirements, the author schedules a series of contrivances serving to intercept and absorb the light rays; then the various types of climbers are catalogued, and the methods of guarding against destruction of chlorophyll in the leaves are outlined. Under each heading a list of the plants showing the particular character is enumerated. The book is therefore intended primarily for reference, and, doubtless, teachers will be glad to add it to their library. The information is arranged under the general headings of nutrition and reproduction, and the chapters follow physiological, not ecological, conceptions. The author states in the preface that he has collated his facts from the works of Haberlandt, Kerner, Ludwig, and other writers. It would have added greatly to the value of the book if he had given references to the original sources.

The Deinhardt-Schlomann Series of Technical Dictionaries in Six Languages: German, English, French, Russian, Italian, Spanish. By Alfred Schlomann. Vol. iv. Internal Combustion Engines. Compiled by Karl Schikore. Pp. x+618; with about 1000 illustrations and numerous formulæ. (London: Archibald Constable and Co., Ltd., 1908.) Price 8s. net.

In noticing the first volume of this series of dictionaries in our issue for May 3, 1906 (vol. lxxiv., p. 6), descriptions of the objects of the series and the methods of treatment were given. The present volume deals with the following subjects among others:—gases and oils; the theory, construction, equipment and erection of internal combustion engines; materials and their economical use; complete plants; and general working and testing. The illustrations, though of necessity small, since the volume is of pocket size, are generally remarkably clear. The excellent alphabetical index with which the volume is provided makes reference easy and will greatly enhance the popularity of the dictionary among technical students and workers.

Highways and Byways in Surrey. By Eric Parker. With illustrations by Hugh Thomson. Pp. xix+452. (London: Macmillan and Co., Ltd., 1908.) Price 6s.

It is unnecessary to praise the charming series to which this book is the latest addition. Mr. Parker's volume will appeal in an especial manner to Londoners, who are within easy access of the delights of which he writes; and it may be hoped that the descriptions of Surrey's natural beauties and historic interests will encourage town dwellers to explore neighbouring counties for themselves. Mr. Parker has many useful hints to students of nature as to the favourite habitats of special plants and animals; and the sportsman, too, will find some guidance of the kind he desires. The sketches make it possible to appreciate the beauty of the highways and byways in Surrey without visiting them.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Students' Physical Laboratories.

I AM truly sorry that the obituary notice published in NATURE two weeks ago should seem to Sir O. Lodge to minimise the work of Prof. Carey Foster and others. I feel sure that nobody can value Prof. Foster's work more than I do, but he had neither the money nor the other opportunities that Prof. Ayrton had in Japan. I admit a little overstrain in the statement that at the time when he created his Japanese laboratory "there were not half a dozen people in Great Britain who had experimented in electricity." I ought to have said that there were only a *few* workers in electricity. I had in my mind that before starting for Japan early in June, 1875, I had the curiosity to count the number of electrical papers published before the Royal Society, and now printed in vols. xxii. and xxiii. of the Proceedings. I had no knowledge of meetings after May 13, 1875, as I lived in Glasgow. At the forty-one consecutive meetings from December 11, 1873, to May 13, 1875, there were in all only five papers read having a bearing on electricity. These were two by Dr. Gore, one by Prof. Adams, one by Messrs. de la Rue, Hugo Müller and Spottiswoode, and one by Prof. Balfour Stewart. I was on my way to Japan when my own first published electrical investigation was described at the Royal Society on June 10, 1875.

I do not think that with a record like this it is worth while to cavil at my statement, for it is to be remembered that Royal Society papers, not electrical, were numerous. For example, at the meeting on June 18, 1874, there were twenty-eight papers, and on June 11 there were eight papers, and not one of these thirty-six papers had anything to do with electricity. I have not referred to a few papers during the year on terrestrial magnetism. It was with impressions due to this knowledge that I first saw the Japanese laboratory, and when I wrote the obituary notice my old feeling of overpowering admiration had come back.

In writing about Finsbury I ought perhaps to have expressed myself more clearly. Sir Oliver Lodge misunderstands me. Everybody knows that at King's and University Colleges, and at many other colleges, students were allowed to work in laboratories, and I can imagine that it was a great privilege to Sir Oliver to work under Carey Foster, whose record as a pioneer, as a teacher, and as a writer is so high that it is almost an impertinence in me to refer to it. Volunteer boys did excellent work in my own laboratory at Clifton College in 1871, just as Kelvin's students had worked much earlier in Glasgow; but I think I was right in saying that in all such cases the students were few in number, and that they were volunteers. My point was that *all* the students at Finsbury had much laboratory work, and they were made to think that laboratory work was much more educational than attendance at lectures. I still think that the reform effected at Finsbury was exceedingly great, and that it was of quite a new kind, for it was not only in the nature of the laboratory work, but in its combination with many other kinds of work, that the reform consisted. I cannot hope to carry Sir Oliver with me, for it is quite evident that he knows of Finsbury only at second or third hand. He seems to think that there were only evening classes. It is true that many of the evening students were of the artisan class; but the day classes were of much greater importance than the evening classes, and students of the ages of sixteen to eighteen coming from secondary schools will not fit into his description.

I am glad to think that Sir Oliver approves of that small part of the Finsbury work of which he has heard. No doubt much may be said for and against some of the Finsbury methods, but I do not care to continue a discussion founded on an obituary notice. I know of no obituary notice which might not be the subject of controversy.

JOHN PERRY.

December 5.

A Model Atom.

THE following attempt to construct a kinematics of an atom may prove of interest to readers of NATURE.

Let a sphere of a certain radius (depending on the given circumstances) be described round each charged particle as centre, and let the radii of these spheres be such that some of the spheres are in contact. The spheres may be called *spheres of interference*, and the points of contact *nodes*. The spheres associated with two oppositely charged particles may be supposed to touch internally, and those associated with two particles carrying similar charges may be supposed to touch externally.

A model atom may now be built up of spheres touching one another in this way. We shall suppose that there is one sphere surrounding all the others, which we shall call the atomic sphere. Within this sphere there may be other spheres which completely surround a number of others. Such groups will be called subatoms.

As the electrons within the atom move about we shall suppose that in general their spheres of interference adjust themselves so that the contacts are preserved; such a motion may be called a *steady motion*, and may be obtained by applying a continuous succession of conformal transformations to a given configuration of the spheres or set of spheres.

When an atom is in a normal state we shall suppose that the outer shell contains either a ring of electrons the spheres of interference of which touch one another in succession, and also touch two other spheres, one internally and the other externally, or a system of electrons at the corners of a polyhedron, the spheres being now arranged so that each one touches all its neighbours and two other spheres as before.

If the two extra spheres are kept fixed the electrons can move round an ellipse, so that the contacts of the spheres are preserved, the radius of a sphere being at any time proportional to the distance of its centre from the radical plane of the two fixed spheres (Steiner's porism). If now the mass to be associated with a given electron or sphere of interference belonging to the ring is inversely proportional to the square of the radius of the sphere, the total mass, kinetic energy, and position of the centre of mass will remain invariable so long as all the contacts are preserved.

When an atom is ionised we may suppose that there is one sphere missing from the ring if the charge be positive, and an extra sphere in contact with two spheres of the ring, but not belonging to the ring, if the charge be negative. If the number of degrees of freedom is calculated by allowing three for each electron and subtracting one for each contact or other geometrical condition, there will be a gain of one degree of freedom for each additional charge, whether it arises from the gain or loss of an electron.

We may suppose that a line spectrum is emitted when a given arrangement of nodes or geometrical conditions is preserved, and a continuous spectrum when the geometrical conditions are violated.

The group of infinitesimal conformal transformations seems the natural one for describing the kinematics of a system within a sphere; it may be built up from successive inversions with regard to spheres, just as the group of displacements of a rigid body may be built up from successive reflexions in different planes; it should be noticed, however, that an even number of inversions are required to produce an infinitesimal change.

An inversion does not alter the type of contact of two spheres when the centre of inversion is external to both, but when it lies in the space between two spheres the type of contact changes, and the spheres become external to one another. This may be regarded as a kinematical description of a radio-active process, for a subatom may be thus brought outside the atomic sphere by a continuous succession of changes. According to this view, an atom would break up whenever one of the centres of inversion happened to lie within the atomic sphere.

We suppose that in general the arrangement of spheres within the atom is not symmetrical; if, for instance, the atom forms part of a molecule, the field of force is not symmetrical, and there seems no reason why the arrangement of the electrons should be so.

In the type of motion which is consistent with a constant value of the energy the velocity of an electron belonging to the ring is directly proportional to the radius of its sphere of interference; this corresponds to a uniform motion in the symmetrical configuration, and may be derived from it by a conformal transformation. The assumptions made with regard to the mass of an electron and the interference of radiations at the nodes may be justified if the velocity of light within a sphere of interference is directly proportional to the radius.

The combination of a positive and negative ion may be pictured by supposing that the extra sphere belonging to the negative ion partly fits into the gap in the positive ion in such a way that it is in contact with two spheres belonging to the ring in the positive ion, and the atomic spheres of the two atoms are in contact. This would give three additional geometrical conditions. It should be noticed that the electrons would be nearer together close to the point of contact, so that the greater part of the mass would be concentrated round this point.

The connection between the number of degrees of freedom and valency is discussed in a paper which will appear shortly in the Memoirs of the Manchester Literary and Philosophical Society. HARRY BATEMAN.

The University, Manchester.

Silk-producing Insects of West Africa.

THE following observations in connection with the wild silk-producing insects of West Africa may be considered of interest. In parts of Nigeria (Ibadan, Ilorin, &c.) the cocoons of *Anaphe infracta*, Wlsm., and *A. venata*, Butler, are used for the production of a cloth termed "Sanyan," which is woven from yarn, spun from the boiled cocoon masses, mixed with native cotton yarns. In a state of nature the silk from the cocoons of both these species is brown or yellow-brown, and is of this colour when exposed for sale in the markets, but another kind of silk, which is brought to Ibadan from Bauchi and Bornu (in N. Nigeria), is pure white in colour, and is called "Gambari," or Haussa silk. This is only obtainable as boiled cocoon masses, and the dried remains of the worms found in them seem to indicate that they are allied to Anaphe. The collectors of this silk are said to gather the worms from the trees, on which they find them, when they are prepared to spin, and to confine them in calabashes.

Experimenting with live worms of *A. infracta*, received from S. Nigeria, I found that, by confining them in the dark, they produced pure white cocoons instead of brown, although the original larval cocoon was of the latter colour. It seems probable that the "Gambari" silk is white by reason of the confinement of the worms in calabashes, as no Anaphe or allied species is known to give a white cocoon naturally. A similar result has been obtained by Lepper in the case of *Attacus ricini* (the "Eri" silkworm of India).

The pupæ of *A. infracta* and *A. venata* are eaten as a delicacy by the people of S. Nigeria. Both species seem almost omnivorous in the larva stage, but the first is said to feed, by preference, upon *Albizzia fastigiata* and a Sterculia sp.

A. Maloneyi and *A. subsordida*, the first of which has apparently a cocoon mass without an envelope, should, I think, be placed in another genus, by reason of the absence from their forewings of the lower radial vein (No. 5).

GERALD C. DUDGEON.

Imperial Institute, November 17.

Vitality of Leaves.

I HAVE in my possession a sprig of *Bryophyllum calycinum* which was cut off a plant in Jamaica six months ago, at the beginning of June. It has still attached to it three leaves, which are quite green, and at the edges of these there are minute new shoots projecting from the crenations. Only a fortnight ago a leaf plucked from it showed its vitality by giving rise to a new shoot when placed on some soil in a pot. This shoot is growing well under a glass in a warm room. During all these months this small sprig has been lying about in different rooms, without any supply of soil or moisture.

Could any of your botanical readers inform me if this degree of vitality, in a detached portion of a plant, is unusual? WALTER KIDD.

December 7.

The Exhibition of Fishes in Museums.

THERE are at least four museums in the United States in which collections of fishes are exhibited "in which the specimens are presented without the usual iron supports, with sufficient space around each fish and in natural colours" (NATURE, October 29, vol. lxxviii., p. 659). These institutions are the Field Museum of Natural History, Chicago; Museum of Comparative Zoology, Cambridge; American Museum of Natural History, New York, and Museum of the Brooklyn Institute.

Furthermore, the last-named museum has an attractive group of fishes of a coral reef amid their natural surroundings, and the Field Museum has two groups of freshwater game fishes. F. A. LUCAS.

Museum of the Brooklyn Institute, Eastern Parkway, Brooklyn, N.Y.

An Electromagnetic Problem.

THE electromagnetic problem enunciated by Prof. Comstock in NATURE of November 19 admits of being solved without any reference to the corpuscular nature of electricity and without going beyond the basis of Maxwell's theory.

If σ be the surface density of the sphere, r its radius at any time, the value of the vector potential at a distance R is $\frac{4}{3}\pi\sigma\dot{r}r^3R^{-3}(x, y, z)$.

Making use of Maxwell's first expression for kinetic energy, $\frac{1}{2}(Fu-Gv+Hw)$, we get for the kinetic energy $\frac{1}{6}(4\pi\sigma r^2)^2\dot{r}^2r^{-1}$, from which the problem can be completed. To understand the question fully we must use the retarded formulæ for the potentials, Maxwell's expression being only the first terms of expansions in descending powers of C, the velocity of radiation. We get in this way more complicated values of the potentials, giving, however, no magnetic force and the original symmetrical electric force.

The question is interesting as supporting Macdonald's view as to the expression for the energy. It also seems to point out that in any æther theory the vector potential must be looked upon as something more than a mathematical abstraction. ARTHUR W. CONWAY.

Cosy Nook, 100 Leinster Road, Rathmines, December 1.

Mercury Bubbles.

I HAVE often observed these bubbles when purifying mercury. They may be produced very easily by shaking mercury and any liquid in a wide stoppered test-tube, and then suddenly bringing the tube to rest, when the bubbles (of varying size) will be formed.

I have tried the following liquids:—water, alcohol, ether, acetone, ethyl acetate, acetoacetic ester, amyl nitrite, amyl alcohol, amyl acetate, carbon tetrachloride, benzene, toluene, xylene, gelatin, glycerin, formic acid, acetic acid, aniline, carbon bisulphide, toluidine, pyridine, ethyl iodide, methyl bromide, ethyl bromide, methyl iodide, dichloroethylene, ethylene dibromide, chloroform; it seems that the more volatile and less viscous the liquid, the smaller are the bubbles and the quicker do they burst.

PHILIP BLACKMAN.

Hackney Technical Institute, N.E.

IN view of the several letters about mercury bubbles which you have recently published, I beg to mention that molten steel is also capable of forming bubbles. If a bucket full of water be placed in a suitable position underneath and a little to the front of a Bessemer converter, then on removing the bucket after the completion of a blow it will be found to contain small spheres of steel ranging in size from a pin's head to that of peas, and even larger. These spheres are hollow, and some are perforated, and occasional ones are twins and triplets, sets of hollow spheres having plunged into the water at the instant they stuck together.

West Didsbury. C. E. STROMEYER.

THE ORGANISATION OF RURAL EDUCATION.

THE two publications of the Board of Education before us, "Suggestions on Rural Education" and "Memorandum giving an outline of the successive legislative and administrative conditions affecting the relation of the Board of Education to Agricultural Education in England and Wales," cast several sidelights on the very curious administrative situation which at present exists with regard to agricultural education in this country. As the memorandum explains, the first move in this direction was taken in 1888–9, when a sum of 5000*l.* was voted in aid of "agricultural and dairy schools," and the administration of this vote was handed over to the Board of Agriculture on its creation in 1890. Almost simultaneously the county councils became charged with provision of technical instruction, and were granted the so-called "whisky money" for its development. The outcome was the creation of a number of schools and colleges of agriculture, some departments of existing universities, others independent institutions maintained by a group or by a single county, supported in the main by county council funds, but also subsidised and inspected by the Board of Agriculture out of its grant of 5000*l.*, which has since grown to 11,550*l.* annually. The institutions thus subsidised by the Board of Agriculture were, however, all of the university or higher technical school type; other agricultural instruction in secondary or primary schools, or by means of evening classes or peripatetic teachers, was provided by the county councils on their own initiative, and not recognised officially by the Board of Agriculture.

The anomaly of thus cutting off part of the educational work of the country from the main stream of education soon attracted attention, and during Sir John Gorst's secretaryship a definite statement was made that the educational work of the Board of Agriculture would be transferred to the Board of Education. However, with Mr. Hanbury's arrival at the Board of Agriculture this idea was dropped, and the Board strengthened its educational staff, while, as may be seen from the report of the Committee on Agricultural Education which reported this year, it appears to desire or to contemplate an extension of its functions. Meantime, however, the Board of Education had been moving in the same direction; it remained the authority dealing with rural education in the primary and secondary schools, and by the appointment of two special inspectors it was evidently taking up the question seriously. This being the case, the manner in which the Board of Education was ignored, both in framing the Committee on Agricultural Education and in calling for evidence, is so remarkable that the recommendations of that committee cannot be regarded as of much weight, so obvious is it that they have given but little consideration to the wider questions involved.

The two documents before us may be taken to indicate that the Board of Education does not regard as settled the question of whether it shall not control the whole of rural education. But the two departments will no doubt be left to settle this in their own departmental way; it may not be amiss, perhaps, to consider the problem a little in the light of the interests of agriculture and education. Clearly the ideal state of affairs is that which prevails in Ireland, where the Board of Agriculture and of Technical Instruction is not divided, but administers the greater part of the money and sets the example to the county councils, instead of following their lead. As a result we have in Ireland, though the work is younger, a coherent system carried out with due regard to economy, which is educating the farmer and not gratifying the short-sighted opinions of local committees. Real work is being done for agriculture, as may be seen from the creation of the early potato industry, the way the flax problem is being attacked, the increased exports of butter, eggs and poultry. In fine, in Ireland there is a thinking head and a continuous policy; in England it is all go as you please, with plenty of good work, but with waste on one side and neglect on the other. The Board of Agriculture cannot exercise any control; even the colleges which it inspects defer but little to its opinion, because they are primarily concerned in satisfying their immediate paymasters, the county councils. As to the general policy of a county in rural education the Board of Agriculture can say nothing, nor is its opinion and advice ever sought in such matters. Probably the Board of Agriculture was right in keeping closely within its appointed function, but whether the result were necessary or not, the fact remains that in practice its opinion on agricultural education generally has never carried much weight, nor have the county councils obtained that help in dealing with rural education which they might have expected. The Board of Education, speaking with a knowledge of what can and cannot be done in teaching, might have saved the country from a good many experiments which were not only expensive failures in themselves, but which left behind a feeling of soreness and distaste for any further meddling with the education of the farmer.

It is too late now to dispossess the county councils of the very large measure of initiative and control over rural education which they obtained as a result of the Technical Instruction Act, but the situation was really vitally changed by the Education Act of 1902, which imposed on every council *the duty of considering all the educational needs of its own area*. Supposing any county is failing to carry out this duty (and there are several which make no provision whatever for agricultural education), it is the Board of Education which will have to apply pressure, for the Board of Agriculture has no title to interfere. Thus the Board of Agriculture is really in an *impasse* as regards that part of agricultural education which it has reserved for itself, the higher technical form; it can aid an established college, but it cannot exercise the least influence on the many counties which neither possess nor share in one of these colleges, nor can it do anything to fill up the blank spaces on the map showing its spheres of influence which it occasionally exhibits when agricultural education is under discussion.

While higher education in agriculture might thus most properly be handed over to the Board of Education, it would never do to allow the Board of Agriculture to lose all contact with the colleges, which should be all acting as intelligence departments, both collecting and diffusing information on its behalf. The Board of Agriculture has another function at present very imperfectly performed—that of being an advisory and investigating agency for the working farmer. Day by day the Board is addressed for information about crops, manures, injurious insects, diseased plants, and so forth; it possesses no scientific staff to deal with such matters; above all, it has no mechanism for investigation; when a new problem comes along some member of the staff either tries to look it up in a text-book or a correspondent is called upon for an opinion.

The way the Board of Agriculture has dealt with some of the diseases which have sprung up of late years would be ludicrous had they not turned out so tragic to some of the farmers concerned, and this has been purely the fault of a system which calls upon the

Board to advise and regulate, but yet gives it no means of obtaining knowledge. By some obscure departmental tradition research is supposed to be outside the scope of the Board of Agriculture—it spends something between 400*l.* and 500*l.* a year in assisting various investigations! But if the Board of Agriculture is to forward the industry of agriculture, its very first business is investigation and research; it must condescend to go to work in the way other countries and our own colonies aid their farmers, and it must have money to do the work with. Now to build up a proper intelligence department, the present grant of 11,000*l.* a year to the Board of Agriculture for educational purposes is none too much; let it be allowed to keep this money and retain its connection with the colleges by using it to promote investigation in them, building up in one a mycological department which would act as consultant for the board, in another an entomological department, and so forth. Meantime let the educational work of the colleges be put under the control of its proper authority, the Board of Education.

THE CHILDHOOD OF MAN.[1]

DR. L. FROBENIUS is a prolific writer on ethnological subjects, and we welcome a translation of a book which gives in popular language the results of his wide reading. The book deals with an extensive range of subjects, upon many of which very diverse views are held, and the English reader will be pleased to be able readily to grasp the point of view of a German ethnologist; but a book, in some cases, has to be judged by what is omitted as well as by what it actually contains.

In dealing with articles of personal adornment the author admits that the objects worn have usually another value than that of pure ornament; he refers to trophies and currency, but entirely omits the very widely spread wearing of "ornaments" for magical purposes. He makes some interesting observations on scarifications of various central African tribes, and alludes to the significance of these and other forms of skin decoration; but, unfortunately, he terms all such tattooing.

The making of shell money he regards as the most peculiar of the reasons for the origin of labour. He quotes R. Parkinson concerning the use and exchange value of the *dewarra.* Under the term of dress-language he refers to strings and belts of wampum, and to the notched and painted eagle feathers of some North American Indians. Also culled from American sources are his accounts of sign and gesture language, but no allusion is made to the gesture language of such peoples as the Australians, Papuans, Neapolitans, and many others. One of the best sections is that dealing with drums and drum language, which he believes has a very wide extension in Africa, and is "convinced that this peculiar drum-language is current throughout Central Africa east of the chain of lakes." He says (p. 86):—"It would appear to be most highly developed in the western parts of equatorial Africa, although scarcely less widespread in Oceania, that is, in the insular lands lying north-west and north-east of New Guinea. In New Pomerania [New Britain] itself the different villages communicate over wide areas by means of the drum-telegraph, which has also a very wide range in the Amazons valley and in Mexico. The North-west Americans, too, possess similar instruments." An interesting modification of the drum, according to him, is the apparatus that is fastened to a bow in Mangbattuland. He makes the interesting suggestion (p. 99) that "the drum is a hybrid sort of instrument, one part of which, the sounding-case, owes its origin to the pounding of corn; the other, the skin, to the measured beat in leather-dressing." The most valuable portion of his account of picture-writing is taken from Hoffman's (not "Hoffmann") contribution to Garrick Mallery's great monograph, to which he does not allude by name.

In the chapter on "skull-worship and head-hunting" he refers to the well-known fact that the preservation of skulls by some people is to ensure the assistance or protection of the spirit of the dead man, which in the next world becomes the servant of whoever captured his skull. Although he does not say so, scalp-collecting had probably a similar significance, as probably had the bunches of human hair which are inserted in some shields from Borneo and Celebes.

In dealing with fetishism he says (p. 184):—

"So long, for instance, as the owners of the ancestral images remember the names and the personalities of the dead represented by them, so long will the object retain

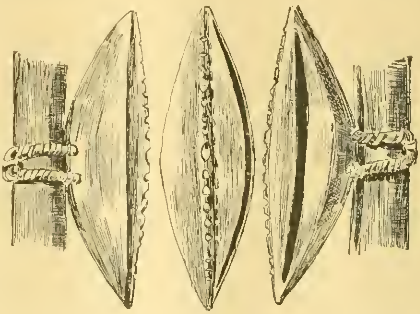

FIG. 1.—The little Signal-drum of the Madi bow. About half natural size. Three views. From "The Childhood of Man."

the type identical in character, essentially the same. But when the memory dies out while the image remains, it will soon happen that the wooden figures will acquire the general significance of a sacred object without any personal value." "When . . . the negro sees any unusual object, he is at once taken with a certain feeling of anxiety, a certain perplexity, and he is ready to believe in a display of power in this object, which exceeds the usual, the commonplace, to the extent that the thing itself looks strange or weird. To put it clearly, the negro attributes a supernatural power to every fresh appearance, to any new object which in any way departs from the ordinary, the known, the intelligible. For him it is uncanny" (pp. 185–6).

But the author does not pay sufficient attention to the fact that a fetish is credited with mysterious powers owing to its being the habitation, temporary or permanent, of a spiritual being, or as being the vehicle or means by which the spirit communicates with his worshippers. The chapter on secret societies and masks is of great interest; it deals mainly with West African conditions, but in the next chapter the author describes the *mide* of the Ojibways. The chapter on sacred animals is scarcely adequate, and totemism he regards, like Mr. Andrew Lang—of

[1] "The Childhood of Man: a Popular Account of the Lives, Customs and Thoughts of the Primitive Races." By Leo Frobenius, translated by A. H. Keane. Pp. 504; with 415 illustrations. (London: Seeley and Co., Ltd., 1909.) Price 16*s.* net.

whom no mention is made—as due to a system of naming.

A third of the book is taken up with the exposition of the solar god in mythology, and the author certainly gives examples of solar and other myths from different peoples, but he presses into this argument various folk-tales which do not seem to have any solar significance. It is true that certain incidents in some of these tales may be paralleled by incidents in folk-tales in other parts of the world which are recognisable as solar myths, for, to take one example, a fishing population is very likely to have in one of its tales the incident of a man being swallowed by a fish; and wherever this occurs the solar mythologists pick out this incident and regard it as a part of the "Jonah-solar myth," although the rest of the tale may have no bearing at all on solar mythology. This incident occurs in folk-tales from various places, and in the Torres Straits tale of Mutuk it is recorded that the hair of that individual fell off when he was in the shark's stomach. The same incident occurs in the North American tale, when Kaig, the Mink, was swallowed by a whale, the loss of hair in this case being due to the heat; in the tale as here given it is not evident that "the cause of the hair falling off is the heat of the sun" (p. 287). The same explanation is offered for the Mutuk incident; by such methods correspondences are readily arrived at, but this is not the place to discuss the modern recrudescence of astral-mythology in Germany.

The bird in symbolic art, according to Dr. Frobenius, bears the soul aloft through the air up to the sun. "But here is the solution of the whole problem; the soul of the dead man follows the sun." He considers that the tales of the cunning spider are survivals of mythological tales in which the spider is regarded as representing the sun. "In the form of rays the sun emits its sea of light; in the form of rays the spider, too, weaves its web. Thus the slender threads of the spider become solar rays and the sun becomes the spider which in artful ways ensnares the souls of mortals. The solar myth, however, became a nursery tale." There are two chapters on the origin of the world, the fall of the sky, the flood, and the theft of fire.

It will be seen that the book covers a broad field and contains much interesting matter, some of which is not easily accessible to the English-reading public; and, indeed, there seem to be some accounts not previously published, but the absence of references renders it difficult to be quite certain on these points, and is, indeed, a very serious blemish in the book. There is a large number of excellent figures and plates, but a great many of these are not explained, and appear to have no bearing on the text. Finally, the book is rather an exposition of the author's views than of those generally held by ethnologists.

A. C. HADDON.

FIG. 2.—The Juju Nkali Feast. From "The Childhood of Man."

ALBERT GAUDRY.

BIOLOGICAL and geological science mourns the loss of Prof. Albert Gaudry, who, full of years and honours, passed away at Paris on November 29. He was one of the most distinguished pioneers in the modern methods of studying extinct animals, and during the past half-century his brilliant expositions and suggestive writings have been among the most potent influences for the direction of palæontological research to profitable ends. In the case of his pupils and those who had the privilege of his personal acquaintance, the charm of his courtly manner and quiet enthusiasm strengthened these influences, and made him a revered master.

Jean Albert Gaudry was born at Saint-Germain-en-Laye on September 15, 1827, the son of a well-known

lawyer. He studied at Paris, where he eventually graduated as Doctor of Sciences. His earliest researches were mainly geological, relating to such subjects as the dolomitisation of limestone and the origin of flint; but in 1851 he wrote about the skeleton of some star-fishes, and his attainments were so varied that he attracted the notice of the French Minister of Agriculture and Commerce, who sent him in 1853 on a scientific mission to Syria, Egypt, Greece, and the Ionian Islands. Gaudry's official report appeared as a publication of the French Government in 1855, dealing with the geology, natural products, industries, and possible commercial development of the several countries visited; but his observations on the geology of Cyprus were so exhaustive that he reserved most of the details for a special memoir, which was issued seven years later by the Geological Society of France. When Cyprus became a British possession in 1878, Gaudry's important work was translated into English and re-published by the Intelligence Department of the War Office.

While travelling in Greece, Gaudry's attention was directed to a remarkable accumulation of fossil bones at Pikermi, between Athens and Marathon, which had been discovered and partially examined by the Bavarians. Collections of the bones had been sent to Munich, and described by Roth and Wagner in the *Abhandlungen* of the Bavarian Academy; but Gaudry realised that more exhaustive exploration would yield important results, and he induced the French Academy to provide him with means for the work in the season 1855–6. He made a large collection, which was sent to Paris and occupied his attention for the next four years; in 1860 he returned to Pikermi to obtain additional specimens that seemed to be required; and between the years 1862–7 he published his classic monograph, "Animaux fossiles et Géologie de l'Attique." This work dealt chiefly with the Upper Miocene (or Lower Pliocene) Mammalia, and was the first systematic attempt to arrange extinct animals of successive geological periods in linear series below their surviving representatives, to illustrate the probable direction of evolution of the several groups. Gaudry showed clearly that the mammals of Pikermi were links between those of earlier date and those of the present day; and he initiated a plan of detailed comparison, especially of the teeth and feet, which has been followed with great success during later years by those who have investigated the numerous extinct mammalian faunas of North America. He recognised that much additional information on the same subject could be obtained by comparing the Upper Miocene (or Lower Pliocene) mammalian skeletons from France itself with those of earlier geological periods already known from that country. In 1866 he accordingly made explorations at Mont Léberon, in Vaucluse, and seven years afterwards his earlier volumes were supplemented by that on the "Animaux fossiles du Mont Léberon."

Meantime Gaudry had joined the staff of the Paris Museum of Natural History, first as assistant (1853) and subsequently as professor of palæontology (1872). Here he came into contact with many workers, and took part in several other researches while his own special studies were in progress. He was particularly interested in Boucher de Perthes's discovery of flint implements with the bones of extinct Pleistocene mammals in the river-gravels of Abbeville; and when Prestwich and others confirmed this discovery in a communication to the Royal Society in 1859, Gaudry added his testimony in a paper read before the French Academy at the same time. The problems connected with early man continued to interest him to the end, and so recently as 1903 he wrote for *L'Anthropologie* an essay on the dentition and lower jaw of human skeletons from the Mentone caves, demonstrating their very primitive characters.

Gaudry's researches on the fossil mammals of Pikermi and Mont Léberon naturally led him to apply his methods of study to other groups; and he planned a great work which should sketch at least the broad outlines of the evolution of life as revealed by palæontology. It was entitled "Les Enchaînements du Monde animal dans les Temps géologiques," and appeared in three volumes between 1878 and 1890, with a supplementary volume, "Essai de Paléontologie philosophique," in 1896. This work is unique as a readable exposition of the science of palæontology, and its beautiful wood-cut illustrations of fossils have never been surpassed. While it was in course of preparation a continual series of original papers recorded the more technical results of the author's researches.

For fifty years Gaudry devoted unbounded energy to the perfection and arrangement of the collection of fossils at the Paris Museum, and when he retired in 1903 his colleagues and friends of every nationality subscribed towards a suitable tribute of admiration. A medal was struck in honour of the occasion. His withdrawal from official duties, however, did not affect his original researches, and until the beginning of his last illness in the summer of this year he was regularly occupied with the study of the remarkable extinct mammals of South America. He arrived independently at the conclusion, which is now very generally adopted, that the mammals of the southern continent evolved separately from those of the northern hemisphere, and remained in a comparatively backward condition.

The whole of Gaudry's published work is characterised by an almost poetic mode of expression; and while detailed descriptions of the fossils are rarely omitted, they are often dispersed among his illuminating comparisons in such a manner that his writings have sometimes been criticised as unsystematic or superficial. Gaudry's extensive travels, however, had made him acquainted to an unusual degree with the fossils of every land, and he realised the limitations of his science too thoroughly to make the dogmatic assertions concerning genealogies and relationships which are not infrequent in the works of some of his followers. In the existing state of knowledge, he was satisfied with broad outlines which could be used for guidance in future more detailed research.

Gaudry became a member of the Institute of France in 1882, and a foreign member of the Royal Society in 1895. Among foreign honours there was none he appreciated more highly than that of the Wollaston medal, awarded to him by the Geological Society of London in 1884. An excellent portrait of him appears in the *Geological Magazine* for February, 1903.

A. S. W.

NOTES.

DR. F. WALKER MOTT, F.R.S., has been elected Fullerian professor of physiology in the Royal Institution.

THE next meeting of the Australasian Association for the Advancement of Science is to be held in Brisbane in January, 1909.

THE annual meeting of the British Science Guild will be held on Friday, January 22, at the Mansion House, by permission of the Lord Mayor. Mr. Haldane, president of the Guild, will be one of the speakers.

IT is announced from Stockholm that the Nobel prize for physics has been awarded to Prof. G. Lippmann, and not to Prof. Planck, as was stated last week. Prof. Lippmann left Paris for Stockholm on December 4.

The recently created Royal Society of South Africa has elected Sir David Gill, K.C.B., F.R.S., its first honorary fellow of the society, "in recognition of his great scientific attainments and of the great help and impetus he has given to scientific research in South Africa."

Dr. W. E. Hoyle, director of the Manchester Museum and lecturer on morphology of Mollusca in the University of Manchester, has been appointed director of the National Museum of Wales. Dr. Hoyle will commence his duties not later than March 25 of next year.

At the annual business meeting of the Scottish Meteorological Society, held at Edinburgh on December 1, Sir Arthur Mitchell, K.C.B., was elected president; Prof. A. Crum Brown, F.R.S., and Sir Archibald Buchan-Hepburn, of Smeaton-Hepburn, Bart., were elected vice-presidents.

Dr. C. E. Beevor, whose death occurred on December 5 at fifty-four years of age, was Croonian lecturer at the Royal College of Physicians in 1903, Lettsomian lecturer at the Medical Society of London in 1907, and also president of the Neurological Society in the same year. Among his publications were scientific papers on the nervous system.

The Bessemer gold medal of the Iron and Steel Institute has been awarded to M. A. Pourcel. The medal is awarded annually for services to metallurgy, and it is for M. Pourcel's investigations in the manufacture of ferro-manganese and for his work on the thermal reaction involved in the manufacture of iron and steel that he will receive it.

The meeting of the Royal Geographical Society on December 14 will be a commemoration meeting of the jubilee of Speke's discovery of the Victoria Nyanza. Sir William Garstin will give an address on fifty years of Nile exploration and some of its results, and there will be an exhibition of portraits, Speke's original map of his discoveries, instruments, photographs, and other objects.

Dr. Azel Ames, whose death is reported from Danvers, Massachusetts, at the age of sixty-three, was at one time prominent among American writers on hygiene. He served as a lieutenant of engineers in the Civil War and as a surgeon in the Spanish War. He had also held various posts under the U.S. Government, in which his knowledge of sanitary affairs was of value.

According to the Paris correspondent of the *Times*, an agreement has been signed between the authorities of the French Congo, the Pasteur Institute, and the Geographical Society, with the object of transforming the French mission for the study of sleeping sickness into a bacteriological institute at Brazzaville. The institute will be placed under the direction and control of the Pasteur Institute in order to ensure the permanence of the organisation.

The Paris correspondent of the *Times* announces that Mr. J. Gordon Bennett has offered the Aéro Club de France, as a new international prize, a cup of the value of 500*l.*, to be competed for next year in France under the auspices of the International Aëronautic Federation and of the French Society for the Encouragement of Aërial Locomotion. In addition, Mr. Gordon Bennett offers three sums of 1000*l.* each to be given to the winner of each of the first three annual competitions.

The death is announced of Prof. E. G. von Rindfleisch, the eminent pathologist, at seventy-two years of age. Prof. Rindfleisch occupied in succession the chairs of pathology at Zürich and Bonn, and in 1874 he succeeded to the chair of pathological anatomy in the University of Würzburg, which had been occupied by the late Prof. Virchow. He devoted considerable attention to the causes and treatment of tuberculosis, and his publications included a manual of the doctrine of cellular pathology, a volume on the elements of pathology, and papers on the principle of life and on medical philosophy.

Prof. Alfred Lodge desires to correct a part of the statement as to his remarks at the recent meeting on the correlation of the teaching of mathematics and science, reported in Nature of December 3 (p. 144). What he suggested was that the science masters should each term furnish the mathematical masters with an epitome of the mathematical knowledge required by each division to enable the pupils to follow satisfactorily the science course of the following term, in much the same way as a mathematical preamble to each chapter or group of chapters of a scientific book would facilitate the understanding of these chapters.

Mr. Alfred Colson, Millstone Lane, Leicester, who was one of the local secretaries for the meeting of the British Association held there in 1907, is preparing an album of extracts, reports, photographs, &c., for presentation to the library of the local Literary and Philosophical Society. He is anxious to obtain as many snapshots as possible of the visitors, and would be glad if photographers would send him negatives (which would be returned safely) or prints to illustrate the album. Photographs taken at the Loggia, the garden-party at Glenfield Frith, the Abbey Park, in the reception room, or at any of the excursions would be particularly acceptable. No doubt many photographers who were present at Leicester will assist Mr. Colson to secure this memento of a successful meeting.

In the issue of Nature for June 11, 1903 (vol. lxviii., p. 129) an article on Mr. W. A. Bentley's photographs of snow crystals was published, in which reproductions were included of some of his photomicrographs, taken from the annual summary for 1902 of the *Monthly Weather Review*. The annual summary for 1907 of the *Review* (vol. xxxv., No. 13), which has reached us, contains another admirable collection of photomicrographs of frost and ice crystals. There are thirty-one plates, which have upon them some 274 separate photographs. The plates are unaccompanied by any letterpress, but a description of the photomicrographs will probably be published later.

A series of fire-tests of importance for the extinction of petrol fires with the aid of such simple means as cloths and sand was carried out by the British Fire Prevention Committee on December 2. Some twenty-four tests were undertaken at the committee's Regent's Park testing station. There was a large attendance of Home Office officials, as also officers from the Admiralty, War Office, London County Council, and other public departments. The tests were of a highly instructive character, and went to prove the efficiency of simple means for extinguishing petrol fires. An official illustrated report will be issued by the British Fire Prevention Committee in due course.

Mr. A. Silva White, assistant secretary of the British Association, has resigned that office, which he has held with conspicuous success during the past four years. The announcement of his resignation will be received with regret by the sectional officers, who, perhaps more than members of the council, are able to appreciate the results of his organisation of the work of the association during

his period of office. The establishment of a Press Bureau is a particular instance of the advantages of combining in an organic system what had previously been left to individual action. At the meeting of the council on Friday last, the cordial thanks of the association were expressed for Mr. White's work, but it was resolved that the assistant secretary should not be a member of the council; and as this was the chief condition under which he would continue in office, his resignation was accepted.

MR. G. C. LLOYD has been appointed secretary of the Iron and Steel Institute in succession to the late Mr. Bennett H. Brough. Since 1904 Mr. Lloyd has been secretary of the Institution of Electrical Engineers, and he was previously assistant to Mr. Brough at the Iron and Steel Institute. We are glad to see that the council of the institute has decided to raise a fund to provide for the education of Mr. Brough's two children, and to give his widow a life annuity. A sum of about 5500*l.* is required; and it is a fine testimony to the high regard in which Mr. Brough's memory is held to know that subscriptions amounting to 2635*l.* were promised by members of the council before the appeal was issued to members of the institute by Sir Hugh Bell, the president. We are confident that the appeal will be responded to generously, not only by members of the institute, but also by numerous other admirers of Mr. Brough's work for pure and applied science. Subscriptions should be sent to the president, Iron and Steel Institute, 28 Victoria Street, London, S.W.

THE director of the Wistar Institute of Anatomy and Biology, Philadelphia, U.S.A., informs us that the anatomical journals published by the institute are to be sent regularly to NATURE. We shall be glad to notice from time to time any articles of outstanding importance and wide interest in these publications. The Wistar Institute, the only institution of its kind in the United States, is an endowed institution, maintaining a free museum of anatomy and a staff for the promotion of researches in this subject. It is rapidly becoming the central anatomical institute for research work in the United States, and its publications are distributed to all the principal laboratories of the world. As a central institute of anatomy it attempts to bring together data, specimens, and literature, and to interchange and distribute them to investigators in such a manner as to promote anatomy and aid those who are devoting their lives to the advancement of human knowledge. To the technical aspects of anatomy NATURE cannot devote much space, but an occasional note upon American progress in that science will be of interest to all biologists.

THE following are among the lecture arrangements at the Royal Institution before Easter:—Prof. W. Stirling, a Christmas course of six experimentally illustrated lectures on "The Wheel of Life," adapted to a juvenile auditory; Prof. Karl Pearson, two lectures on albinism in man; Prof. A. A. Macdonell, three lectures on the architectural and sculptural antiquities of India; Dr. F. Walker Mott, six lectures on the evolution of the brain as an organ of mind; Prof. J. O. Arnold, two lectures on mysteries of metals; Dr. Hans Gadow, three lectures on problems of geographical distribution in Mexico; Mr. A. D. Hall, two lectures on recent advances in agricultural science; Prof. G. H. Bryan, two lectures on aërial flight in theory and practice; and Sir J. J. Thomson, six lectures on properties of matter. The Friday evening meetings will commence on January 22, when Dr. Alfred Russel Wallace will deliver a discourse on the world of life: as visualised and interpreted by Darwinism. Succeeding discourses will probably be given by Sir Frederic Nathan, Prof. J. G. Frazer, Prof. H. A. Wilson, Sir Henry Cunynghame, the Earl of Berkeley, Mr. S. G. Brown, Mr. R. Threlfall, Mr. A. S. Eddington, and Sir J. J. Thomson.

TO-MORROW (December 11) a new wireless telegraphy station is to be opened at Bolt Head, near Kingsbridge, South Devon. The Postmaster-General is expected to be present. The station is about fifteen miles south-east of Plymouth, the Start being seven miles to the eastward, and Prawle Point, where Lloyd's station is fixed, between four and five miles. Bolt Head stands 350 feet above the sea-level, which is considerably higher than the Marconi station in Cornwall. The work was begun about six months ago, and is estimated to cost about 10,000*l.* We learn from the *Times* that an eight horse-power oil engine with dynamo and electrical appliances has been put down. The power is 110 volts, and there is large storage capacity for night work. The radio-telegraphic instruments are a combination of the Marconi and patents owned by the G.P.O., and one or two of Mr. Marconi's staff have assisted in laying down the plant. If the experiment is found satisfactory it is anticipated that the Government will provide other stations. It is stated that the station at Bolt Head will be open for public messages during the first week in January.

THE German Government has decided to send an expedition to the southern part of German East Africa to examine, and make a careful collection from, the remarkable deposit of Dinosaurian bones discovered last year by Prof. Eberhard Fraas in the Upper Cretaceous formation of Tendaguru, in the Lindi district. According to the report of Prof. Fraas, published last August (*Palaeontographica*, vol. lv., pp. 105–144, pls. viii.–xii.), the deposit resembles that of the famous Bone Cabin Quarry in Wyoming, from which the Americans have obtained so many remarkable gigantic reptiles. The huge bones lie weathered out on the surface of the ground, and can be followed by digging into the sandy marl and sandstone beneath them. Many of the bones are in their natural relative positions, showing that at least some parts of the skeletons were buried before their surrounding soft parts had decayed; and Prof. Fraas publishes a striking photograph of a nearly complete hind limb and foot before removal from the excavation in which it lay. All the specimens brought back by Prof. Fraas for the Royal Württemberg Museum in Stuttgart, where they are now mounted, belong to a large herbivorous Dinosaur which he names Gigantosaurus. They appear to represent an animal from 14 to 15 metres in length, closely related to the well-known Diplodocus and Morosaurus from Wyoming. The skull remains unknown, but both vertebræ and limbs are represented by numerous specimens. Further explorations will probably result in the discovery, not only of the missing parts of Gigantosaurus, but also of other reptiles which must have lived with it.

IN the death of Dr. E. T. Hamy, professor at the Muséum d'Histoire naturelle (1892), member of the Académie des Inscriptions et Belles-lettres (1890) and of the Académie de Médicine (1903), anthropologists have lost a learned colleague and France an illustrious savant. Jules Théodore Ernest Hamy was born at Boulogne-sur-Mer in 1842, and was always profoundly attached to his native district, as is testified by the eleven memoirs on its archæology published in the *Mémoirs de la Société academique de Boulogne-sur-Mer*, in the *Bulletin de la Société d'Anthropologie de Paris*, and in the *Revue d'Anthropologie*. He published his valuable pioneer work,

the "Précis de Paléontologie humaine," in 1870. In 1873 he was appointed "aide naturaliste" to De Quatrefages, then professor of anthropology at the museum, and in collaboration with him published the classical work "Crania ethnica" (1875–1882); of equal value is his great "Anthropologie du Mexique" (1884, 1890, 1891). His interest in American archæology and ethnography is evidenced by the "Decades Americanæ" (1883–1899). In 1880 he was appointed director of the Musée d'Ethnographie, then recently installed in the Trocadéro, which post he held for twenty-six years; but despite his incessant efforts, lack of funds prevented him from developing it according to his desires. In this connection he published the "Origines du Musée d'Ethnographie" (1890) and the "Galerie americane du Musée d'Ethnographie du Trocadéro" (1897). The geographical aspects of ethnology had an attraction for him, his most important contribution being the "Études historiques et géographiques" (1896). Most of his ethnographical essays were published in the *Revue d'Ethnographie et Anthropologie* (1882–9). Dr. Hamy possessed a great range of knowledge and sane judgment, and it is not only in France that his loss will be felt.

ALTHOUGH there is a slight increase in the list over that of the previous year, the council of the Ealing Scientific and Microscopical Society, in its report for 1907–8, urges the necessity for new members. Abstracts of the lectures delivered last session are included in the report.

FOUR out of the five papers in vol. ii., No. 3, of the Journal of the Federated Malay States Museums are devoted to the mammals of the district, Mr. O. Thomas describing new species from Tioman and Aor Islands, in the South China Sea, while Mr. Boden Kloss contributes lists of the species inhabiting the Malay Peninsula and neighbouring areas. It is sad to see such well-known names as *Macacus cynomolgus* and Galeopithecus respectively replaced by *Macaca fascicularis* and Galeopterus.

THE ovum of mammals forms the subject of two papers (each issued only in preliminary shape) in No. 6 of the Bulletin of the Royal Academy of Belgium. In the first of these Messrs. Winiwarter and Sainmont announce the discovery that, in the cat at any rate, the functional ova are developed during post-fœtal life, whereas it has hitherto been supposed that in all mammals this took place *in utero*, or during the very earliest stages of extra-uterine development. The second paper, by Dr. O. Vander Stricht, is devoted to the development of the ovum in bats, as represented by the noctule.

THE whole of the second number of the Annals of the Transvaal Museum is devoted to an account of the numerous species of ticks infesting South Africa. According to the author, Mr. C. W. Howard, entomologist to the Mozambique Government, these pests have hitherto been studied only in relation to the transmission of disease, so that little has been known with regard to specific characteristics and the variations (which are great) presented by the different species. These gaps in our knowledge are to a great extent filled by Mr. Howard's paper, although, as might be expected, much work still remains to be done.

FOR some time a discussion has been going on in the columns of the *Emu* with regard to the food of Australian cormorants and the harm these birds are alleged to inflict on the local fisheries. The discussion is continued in the October number of that journal, where it is emphatically affirmed that, instead of subsisting exclusively on fish (as is universally stated to be the case with all cormorants), these birds feed very largely upon crabs and shrimps, which themselves are harmful to fisheries on account of their partiality to fish-spawn. Moreover, instead of subsisting very largely on the introduced trout, as has been alleged, the local cormorants are stated to be much more fond of eels, which are of little importance as food-fish.

IN a notice of the badger in Norfolk, published in the November number of the *Zoologist*, Mr. A. H. Patterson gives a qualified assent to a theory suggested by Mr. T. Southwell, that the aboriginal stock was at one time totally exterminated, and the existing representatives of the species are the descendants of animals turned down in consequence of their usefulness in forming earths for foxes. If this be so, the practice of huntsmen in regard to badgers in Norfolk is different from that obtaining in certain other counties we could mention. It is satisfactory to learn that Norfolk badgers are now on the increase.

WE have been favoured by the author, Mr. R. B. Newton, with copies of two papers from the Proceedings of the Malacological Society, one on relics of coloration in fossil shells, and the other on fossil pearl-growths. The former is illustrated with a plate showing colour-pattern on shells from the Silurian upwards. The author mentions the theory that such patterns may be taken to indicate the comparatively shallow-water habitat of the shells in which it occurs, and the objections taken to the same, but fails to give his own opinion on the matter. Pearls or pearl-like growths are shown in the second paper to occur in fossil shells of the genera Volsella (Mytilidæ), Inoceramus (Aviculidæ), and Gryphæa (Ostræidæ), most of these being of Cretaceous age.

NEW discoveries of fossil fishes and arthropods in the Middle Coal-measures of Sparth, Rochdale, Lancashire, form the subject of a paper by Mr. W. A. Parker in vol. ix. of the Transactions of the Rochdale Literary and Philosophical Society. The fish-remains include scales of species of Ctenodus and *Strepsodus sauroides*, as well as a nodule enclosing a nearly entire specimen of a probably new member of the palæoniscid group. Of greater interest are the arthropod fossils, which include eight new species, namely, two of Eoscorpius, three members of the king-crab group referable to the genus Belinurus, a pedipalpate arachnid of the genus Geralinura, a member of the shrimp-like Pygocephalus, notable as being the only specimen exhibiting the whole dorsal surface, and a myriapod referable to Xylobius. Examples of previously known arthropods are likewise recorded.

AN issue (vol. iii., No. 4) of the botanical series of the *Philippine Journal of Science* is devoted to two sets of identifications of insular plants. The majority of the specimens described by Mr. C. B. Robinson, under the title "Alabastra Philippinensia, II.," are shrubs or trees collected by Mr. R. S. Williams. The euphorbiaceous genus Cleistanthus, supplying several new species, is specially summarised. The second paper, contributed by Mr. E. D. Merrill, contains the diagnoses of many new species and a new genus, Sagittipetalum, of the order Rhizophoraceæ, that grows in the dipterocarp forest. The species of Homalium, a genus furnishing important trees, are differentiated with the help of a key.

BULLETINS dealing with ground-nut and fig cultivation in southern India have been published by the Department of Agriculture, Madras. The notes by Mr. H. C. Sampson on ground-nut cultivation refer to the "Mauritius"

variety, that has replaced the native or "country" variety. In some districts quick-growing millets are planted as a catch-crop. Mr. C. K. Subba Rao is responsible for the pamphlet on fig cultivation. The red, loamy soil and temperate climate of Bangalore and Bellary provide conditions suitable for the fig tree. Artificial pollination, known as "caprification," is not practised, nor are the figs dried for market, owing, presumably, to the ready sale that exists for the fresh fruit

THE results of two years' experiments obtained on various estates and at the sugar experiment station, Jamaica, are reviewed by Mr. H. H. Cousins in his report recently published by the Board of Agriculture. A fact of considerable interest is the value of small dressings of lime on the sugar plantations. In accord with manurial experiments elsewhere, the application of a manure rich in nitrogenous matter is essential and profitable. With regard to new seedlings of value, the well-known variety B. 208 has proved to be eminently satisfactory for all districts, but even better results are expected from seedlings raised on the island within the last five years.

FROM Prof. Haberlandt's laboratory at Graz there has been issued another paper on the perception of light by plants, that is published in the *Sitzungsberichte der kaiserlichen Akademie der Wissenschaften*, Vienna (vol. cxvii., part ii.). The author, Dr. K. Gaulhofer, has studied the epidermal cells of the leaves of certain plants that take up a fixed light position, and suggests that an explanation may be found in the presence of pits or clefts in the cell walls acting as light distributors, in a similar manner to Prof. Haberlandt's "lichtsinnesorgane." The rays of light impinging on the edges of the pits are deflected, and consequently, underneath the pits, shadows are produced. Good instances of such pits occur in *Aporrhiza paniculata* and *Banisteria splendens*, while *Hyperbaena laurifolia* and *Abuta concolor* show well-marked clefts. The combination of pits and curved cell wall in *Cocculus laurifolius* will repay examination.

THE increasing use of artificial manures in South Australia—a sure sign of advance in agricultural methods—forms the subject of an interesting article in a recent issue of the *Journal of Agriculture of South Australia*. During the last ten years the total acreage under cereals has remained fairly constant, but the proportion receiving artificial manures has increased from 12 per cent. in 1898 to 68 per cent. during the present year. The steady and continuous nature of the increase is seen in the following table:—

	Total area under cereals, acres	Area receiving artificial manures, acres
1898	2,148,000	230,000
1900	2,298,000	500,000
1902	2,144,000	845,000
1904	2,154,000	1,170,000
1906	2,063,000	1,321,000
1908	2,154,000	1,456,000

Superphosphate is by far the commonest artificial manure used; at present it is imported, but as large quantities of mineral phosphates are known to occur in South Australia, there seems no reason why it should not be made on the spot.

MR. H. LING ROTH, honorary curator of the Bankfield Museum, Halifax, issues as one of his periodical Bulletins an interesting study of "Trading in Early Days." He suggests that the most primitive form of trading is to be found in the exchange of presents among certain members of savage tribes. He discusses the questions connected with silent trade, secret bargaining, early forms of transport and markets, the evolution of notation and currency, all illustrated by excellent photographs from the collections under his charge.

THE University of Philadelphia has undertaken a series of excavations in the Isthmus of Hierapetra, in Crete, the results of which for the year 1906, and so far as the site of Vasiliki is concerned, are described in the second volume of the Transactions by Mr. R. H. Seager. The remains extend over the second and third stages of the early and the first of the Middle Minoan periods. Though the ground has suffered much from denudation, some valuable discoveries have been made—a beehive tomb at Hagios Theodoros, believed to be the second of its kind belonging to the Bronze age that has been found in Crete; a series of houses, and much fine pottery. In connection with this last Mr. Seager makes the interesting statement that the mottled ware of the third Minoan period is of a type commonly in use at the present day in south India from Tuticorin to Madras, while that of the fourth period strikingly resembles the modern domestic ware of the Rajput States. The writer, in agreement with Profs. Ridgeway, Bosanquet, and others, regards as an early form of currency a number of curious axes, these weapons being obviously too small and weak to serve any industrial or military purpose.

DR. J. M. PERNTER has sent us the year-book of the Austrian Central Meteorological Office for 1906. The number of stations then included in the system was 409, of which forty-two ranked as observatories or stations of the first class, *e.g.* possessing self-recording instruments. The observations are arranged according to the class of station; some include hourly values, while at others tri-daily observations or simply mean results are given; several organisations, including the Hungarian, publish their observations separately. The Central Office takes part in the international monthly balloon ascents for the investigation of the upper air, and also issues weekly reports of earthquake phenomena observed at several of the principal observatories. An appendix contains valuable discussions (1) of thunderstorms and hail in Bohemia in 1905 and 1906, by Dr. F. Augustin, and (2) measurements of solar radiation at Vienna from March, 1904, to September, 1906, with Angström's compensation pyrheliometer. The results are exhibited both statistically and graphically by Dr. R. Schneider, and show, *inter alia*, that the solar intensity on a perpendicular surface of 1 cm^2. attains its maximum of 740 gram calories *per diem* at the beginning of June, and its minimum of 245 calories *per diem* in December.

THOSE who have the designing of glass gauges and other glass apparatus to withstand high pressures will find a number of useful tables of breaking stresses of tubes subjected to internal pressure and of filaments subjected to tension in Communication No. 106 from the Physical Laboratory of Leyden, by Prof. Kamerlingh Onnes and Dr. Braak. Although the numbers in the tables differ considerably from each other in many cases, it seems that tubes break when the pressure inside makes the maximum tension in a direction perpendicular to the axis equal to about 5 kilograms per square millimetre, and that filaments in tension break at about 17 kilograms per square millimetre at ordinary temperatures, and at about 30 kilograms at the temperature of liquid air.

IN X-ray work it is necessary that the current through the tube shall be unidirectional. There are devices in existence by means of which the behaviour of the tube

can be tested. There are also devices by means of which the unidirectional character can be brought about, but these devices usually impair the performance of the tube. We have had the opportunity of examining an arrangement recently brought out by Messrs. F. R. Butt and Co., of 11 Denmark Street, W.C. The usual primary of the induction coil is surrounded by a subsidiary coil consisting of a single layer. This second coil can be short-circuited at any time, and it is so connected with a revolving break that it is short-circuited just prior to the make of the primary. The induced E.M.F. at the secondary terminals is thereby so far diminished that no discharge occurs there at the make. The subsidiary coil is immediately afterwards interrupted by the revolving break (and for greatest efficiency this interruption must occur when the current in the primary coil has a stationary value); the discharge at break of the primary circuit then takes place without being in any way reduced by the presence of the subsidiary coil. The result is a unidirectional current as perfect as could be desired. There are other details of the coils turned out by this firm which are of interest. In particular, the iron core, consisting of iron wires, is laid with these wires arranged in groups, which are insulated from one another with the object of thoroughly preventing the formation of Foucault-current circuits in the iron.

A SUPPLEMENTARY list of new apparatus for physical demonstrations, just issued by Messrs. Newton and Co., contains particulars of the nature and use of a number of important instruments. By arrangement with Mr. W. Duddell, F.R.S., Messrs. Newton are enabled to supply the complete apparatus for his well-known experiments with musical arcs. A universal optical bench and projection apparatus, designed by Mr. F. J. Cheshire, provide a means of demonstrating many important facts as to light and colour by projection. The same apparatus, with accessories, can be used to illustrate the optical properties of the human eye, and the principles of the telescope, microscope, and other optical instruments. Dr. R. S. Clay's apparatus for the production of waves and ripples in water and their projection upon a screen provides a particularly instructive means of illustrating interference effects. Lecture-table apparatus to demonstrate the properties of selenium and their application in the transmission of pictures by telegraphy is also described, together with other devices of interest to teachers and students of physics. The list should be seen by all who are contemplating the provision of new apparatus necessary for modern physical demonstration.

OUR ASTRONOMICAL COLUMN.

THE SPECTRUM OF COMET MOREHOUSE, 1908*c*.—In No. 21 of the *Comptes rendus* (November 23, p. 951) MM. Deslandres and Bosler publish some very interesting results derived from spectrograms of comet 1908*c*, taken with a slit spectrograph of 0·12 m. (4·7 inches) focal length, and a ratio of aperture to focal length of about 1 : 3.

On spectrograms obtained previously with a prismatic camera, MM. Deslandres and Bernard found that certain lines of unknown origin in the spectrum of this comet, as, also, in that of comet Daniel photographed last year, were double, and it was partly to determine the reality and nature of this doubling that the slit spectrograph was employed.

Two spectra were obtained, and they show that double lines really do exist at the approximate mean wave-lengths 470·00, 456·10, 453·10, 426·7, and 401·3. Moreover, the intervals between the components vary, approximately, with the wave-length, so that the ratio $\Delta\lambda/\lambda$ is practically constant.

Another remarkable feature, noted in the case of those radiations produced by the tail, is that the lines show different inclinations to the length of the spectrum, and it is suggested that this may be due to the fact that the particles of matter emitting the respective radiations were being acted on differentially by the solar repulsion; if this is the true explanation of the phenomenon, we have an experimental proof of the truth of Bredichin's theory.

In the longest lines, extending well into the tail, there is also a marked inflexion at some distance from the head, and the authors suggest that this phenomenon may be due to rotation of the tail.

Previous researches with the prismatic camera gave MM. Deslandres and Bernard no indications of polarisation in the components of these doublets; it therefore seems probable that the doubling is not a Zeeman effect. From the fact that the intervals separating the components appear to bear a constant ratio to the wave-length, it would seem rather to be a Doppler effect, but the researches must be carried much further ere any conclusion can be definitely accepted.

THE CHANGES IN THE TAIL OF COMET MOREHOUSE.—From No. 12 of the *Gazette astronomique* (November 30, p. 93) we learn that the photographs of Morehouse's comet, taken at the Juvisy Observatory, confirm the peculiar phenomena of the tail observed at Greenwich, Stonyhurst, and other observatories. Not only do they show the ebb and flow of activity, probably caused by the comet encountering masses of meteoritic matter of different densities, but they also afford proof that the conspicuous agglomerations in the tail suffered an acceleration in velocity as they receded further and further from the head.

DETERMINATION OF LONGITUDE BY WIRELESS TELEGRAPHY.—The *Comptes rendus* for November 2 (p. 819) contains a report, by M. Bouquet de la Grye, on behalf of the wireless telegraphy committee of the Académie des Sciences, dealing with the subject of the determination of longitude at sea by the aid of wireless telegraphy.

After reviewing the immense importance to navigators of this question, and the various methods by which longitudes have hitherto been determined, the report discusses the possibility of sending signals, at pre-advertised hours, from the summit of the Eiffel Tower. It is concluded that such signals could be sent, say, at midnight, when there would be least interference, and that ships in any part of the Atlantic, for example, could thereby receive their correct time necessary for the determination of longitude. A recommendation that the necessary experimental apparatus be erected on the Eiffel Tower as soon as possible was elicited from the Bureau des Longitudes, endorsed by the committee, and forwarded to the Ministers of War and Marine.

SPECTROSCOPIC BINARIES.—The November number of the *Astrophysical Journal* (vol. xxviii., No. 4) contains two papers by Mr. Plaskett, of the Dominion Observatory, Ottawa, dealing respectively with the orbits of the spectroscopic binaries ψ and ι Orionis.

For the former, the results show an abnormally large range of velocity, about 288 km., and a period of 2·52588 days; the apparent length of the semi-major axis of the orbit is 4,995,100 km.

The application of a least-squares solution to the data given previously for the orbit of ι Orionis has amended the orbit to some extent. The final elements give the ellipticity as $0{\cdot}7543 \pm 0{\cdot}0046$, the period as 29·136 days, and the apparent length of the semi-major axis as 28,907,000 km.

A RECENT OBSERVATION OF NOVA CYGNI.—From a plate exposed for two hours, Dr. Karl Bohlin estimates that Nova Cygni (No. 2), 1876, was of the fourteenth magnitude on October 22. From January 8, 1877, to March 24, 1882, the magnitude of this object sank from 6·7 to 14·0, and recent measures have given the following magnitudes:—Burnham, 1891·6, 13·5; Barnard, 1901·9, 15·6; Bohlin, 1908·8, 13·5. On the Dunecht scale of magnitudes Barnard's and Bohlin's results are between 15·0 and 14·3, and 14·0 respectively (*Astronomische Nachrichten*, No. 4286, p. 226, November 28).

SOME RECENT PUBLICATIONS OF GEOLOGICAL SURVEYS.

THE active Geological Survey of Great Britain has issued its "Summary of Progress for 1907" (1908, price 1*s.*), which is no mere departmental report, since it contains a number of original memoirs. One of these is by Dr. Flett, on the rocks styled mugearites, which may be described as dolerites rich in oligoclase and olivine, but poor in augite. These have now been found among the Carboniferous lavas of East Lothian and Midlothian, where they closely resemble Mr. Harker's original Cainozoic types from Skye. Two other memoirs deal usefully with new sections along English railways. Perhaps the most interesting feature of the general descriptions of the year's work is the insight given (p. 66, &c.) into the progress of the survey of Mull, from which much that is new may be expected.

The full memoir on "The Small Isles of Inverness-shire (Rum, Canna, Eigg, Muck, &c.)," by Messrs. Harker and Barrow, is now also published (1908, price 4*s.* 6*d.*). In chapter iii., the Mesozoic strata of Eigg and Muck are dealt with; Upper Cretaceous sandstone, 2 feet thick, has now been discovered in Eigg, resting on Oxfordian shales. Mr. Harker, following the lines of his masterly memoir on Skye, reports on the igneous series of Cainozoic age which forms the main mass of the islands. He lays much stress on the occurrence of intrusive sills, which have been regarded previously as lava-flows. Tuffs and gravels occur, and numerous true basaltic flows; but the author believes the famous mass of pitchstone that forms the Sgùrr of Eigg to be intrusive in the sills and lavas, and not a flow resting in an old valley-floor. This matter has already been discussed before the Geological Society of London. We have similarly heard already of the Cainozoic gneisses of Rum, produced by the intrusion of granite into eucrite (p. 105); but here we have a complete account of them, in which their similarity to some of the pre-Cambrian gneisses is pointed out. It is, of course, well known from field-observations by Callaway and others that some of our ancient banded gneisses have also arisen from an intermingling of acid and basic igneous rocks.

Photo.] [*J. G. Stenhouse.*

FIG. 1.—Cretaceous Sandstone resting on Oxfordian Strata, Laig Bay, Eigg.

The southern part of the Derbyshire and Nottinghamshire coalfield is dealt with in a memoir explanatory of Sheet 125 (1908, price 3*s.*). The accompanying map (1*s.* 6*d.*) was drawn up in 1907, and includes the drifts, which here play no great part in the surface geology. The "solid" rocks range from Carboniferous Limestone up to Keuper marl, and almost all provide material of industrial value. Even the lead-mines in the north-west of the area show signs of revival. Messrs. Gibson and Wedd furnish an interesting sketch of the great variety of scenery to be met with in the country north of Derby. The term "Yoredale rocks" has been abandoned in this area (p. 8), but the typical "Pendleside series" has not as yet been traced. Numerous new observations are made on the coal-bearing strata, and the drifts are now described for the first time. In the north-east of the area, certain esker-like mounds (p. 165) are referred to the action of the Irish Sea glacier, which sent out a lobe thus far into the Midlands.

Mr. W. A. E. Ussher describes "The Geology of the Quantock Hills and of Taunton and Bridgwater" (1908, price 2*s.*) in a memoir accompanying Sheet 295 (1907, price 1*s.* 6*d.*). The map gives a picture of the great alluvial flat at Bridgwater, above which the Quantocks, formed of hard Devonian strata, rise boldly on the west. The occurrence of Carboniferous Limestone at Cannington Park, and of cherty Lower Culm-measures resting on Upper Devonian in the region to the south-west, gives rise to an interesting discussion (p. 33), in which it is urged that these two series are contemporaneous. Mr. H. B. Woodward adds a chapter on the Lower Lias near the Bristol Channel north of Williton.

The memoir on "The Geology of the Country around Oxford," by Messrs. Pocock, H. B. Woodward, and Lamplugh (1908, price 2*s.* 3*d.*), accompanies a specially arranged map with Oxford in the centre (1908, price 1*s.* 6*d.*). These publications are sure to have a rapid sale, and the colour-printed map, although it includes drifts, gives a very clear indication of the structure of the country. Mr. Lamplugh places the Shotover Sands (p. 66) as Wealden; on the east, near Great Milton, they are overlain by Gault, apparently without the intervention of marine Lower Greensand strata. This unconformity has been noticed elsewhere (p. 75) by Dr. A. M. Davies. The plateau-drift, a deposit older than the highest alluvial terraces of the streams, is correlated (p. 102) with the chalky boulder-clay of regions to the east. Might we not ask, in a memoir of such wide interest, for some of the photographic illustrations, connecting surface-features and geological structure, which are so liberally furnished by the survey for less accessible districts? Large parts of rural and industrial England still require adequate illustration. In this matter, colonial surveys are a bright example to us.

In the concluding part of the *Jahrbuch der k.k. geologischen Reichsanstalt* for 1907, lvii. Band (1907), Dr. F. E. Suess describes (p. 793) the structure of the narrow Carboniferous basin of Rossitz, on the Bohemian and Moravian border. The Culm-measures and Devonian strata are unconformably overlain, and mostly concealed, by Upper Carboniferous and Permian beds, to many of which a desert origin is ascribed. Periodic floods swept down banks of pebbles, and some of the Carboniferous conglomerates are regarded as the remains of land-slides. The great intrusive masses of granite and diorite in the

Brunn area to the east must have been covered by the older sediments, since they yield no pebbles to the conglomerates, and their present proximity is due to faulting.

In the succeeding part (lviii. Band, 1 Heft, 1908) Herr P. S. Richarz describes (p. 1) the hills traversed by the Danube between Hainburg and Pozsóny (Pressburg), a region of the most romantic interest. His sections on pp. 31 and 32 recall the towers climbing up on both sides along the crags, and the narrow passage eastward into lands long subject to the Turk. Beneath the castles of Theben on the north and Hainburg on the south, Lias limestone rests on an old series of phyllites and schists. The crystalline character of the schists is attributed to the action of the intrusive granite of the Little Carpathians, and the alteration of the Lias points to a post-Jurassic age for this intrusion. The author does not wish to extend this conclusion to the Carpathians in general, since the granite of the High Tatra is known to be pre-Permian. He is a supporter of the potency of contact-metamorphism in producing types of rock previously attributed to dynamic action, and on p. 48 he connects the rock-sequence in the Hainburg area, through the Leitha range, with the Semmering region, where the metamorphosed Kossen beds recall the crystalline Lias of the Little Carpathians. Herr F. Broili (p. 49), in describing remains of the amphibian Sclerocephalus from the "Gaskohle" of Nürschan, in Bohemia, enters fully into the question of the age of this deposit, and concludes in favour of its being Upper Carboniferous rather than lowest Permian. Frič has previously treated it as Permian. Herr W. Hammer (p. 79) furnishes a detailed paper on the Ortler Group and the Ciavalatschkamm, which should appeal to climbers as well as to professed geologists. Divergent views have been held regarding the structure of this region, and the author was entrusted with the preparation of a detailed geological map, which will be published in 1909. His conclusions are opposed to those of Termier, who would introduce the principles of "Nappismus" to explain the folding of this part of the eastern Alps (p. 194).

In the *Verhandlungen* of the same institute, Dr. Franz Kossmat (Nos. 2 and 3, 1908, p. 69) describes the country on the Isonzo round Karfreit (Kobarid or Caporetto), a region rarely traversed by the modern traveller, though it lies on one of the highways to Trieste. An overthrust here brings Triassic dolomite above Flysch beds, which are probably of Cretaceous age. The Jurassic to Eocene floor of the basin of Flitsch, which is finely seen, surrounded by Triassic limestones, as one comes down from the Predil Pass, is regarded by the author as the nose of a synclinal pushed over into the Triassic area from the south-east. He has to resist the temptation of treating it as a "Fenster" in this region of conspicuous overthrusts. In Nos. 5 and 6, 1908, p. 111, Herr Wegner, of Breslau, adds considerably to our knowledge of the mammalian fauna of Oppeln, in Silesia. He points out that *Pliopithecus antiquus*, though represented only by teeth and jaws, is so widely spread in the Upper Miocene of Europe that it may be regarded as a characteristic fossil.

In No. 7, Herr Petrascheck (p. 140) describes the relation of the Sudetic mass to the adjacent part of the Carpathians, and supports the views of Suess, with some minor modifications. He thus urges that pre-Miocene folding had much to do with the present structure of the Sudetic area.

The late Mr. T. Barron's memoir on "The Topography and Geology of the District between Cairo and Suez" has been issued by the Survey Department of the Finance Ministry of Egypt (Cairo, 1907). It will be new to many who know the railway that runs close beside the Ismailia Canal to learn that traces of a direct and older line lie to the south of it, in more broken country, and near the historic post-road. The great macadamised road is now becoming lost in sand. The rocks described from this desert region are Cretaceous and Cainozoic. On p. 112 there is a striking passage, in support of Prof. Lapworth's view of the migration of earth-folds as advancing crust-waves; the author traces a trough into a wave-crest and then into a succeeding trough, as he surveys the history of his district from Eocene to Middle Miocene times. Practically the same succession is seen in the Paris basin, and we wish that Mr. Barron had been spared to state his views as to the further course of the wave that has controlled the deposits of Lower Egypt.

From the Geological Survey of India we have received Mr. Hayden's "Geology of Tsang and Ü in Central Tibet" (Memoirs, vol. xxxvi., part ii., 1907). The foliated biotite-granite of the Himalayas is continued into this region, and is undoubtedly intrusive in Jurassic rocks, which cover the greater part of the area. The Eocene marine beds do not contain nummulites, and may be older than the nummulitic stage of other areas (p. 56). The memoir includes photographic plates showing fine outcrops of strata on almost barren mountain sides. Part iii. of vol. xxxvi. of the Records of the same survey (1908, price 1 rupee) contains several palæontological papers, one of which, by Mr. Vredenburg, reviews the Cretaceous species of Orbitoides in India. Dr. Bleeck, of Munich (p. 164), describes the occurrence of corundum in metamorphic limestone in the Kachin Hills of Upper Burma. He urges that the crystalline limestone originated here, at any rate, by contact-alteration of a sediment, under conditions of pressure sufficient to produce corundum and to impart a foliation to the invading granite.

Photo.] [*W. Beattie and Co., Auckland.*

Fig. 2.—The Town of Coromandel, Auckland, situated on Recent Deposits at the foot of hills formed of pre-Jurassic sediments.

The Geological Commission of the Colony of the Cape of Good Hope, working under conditions of peculiar difficulty, has already issued in 1908 four large geological sheets of the map of the north-west area, including Mafeking, Vryburg, and Kimberley. These can be bought in London from Messrs. Wesley and Son, price 2*s*. 6*d*. each. The unconformity between the glacial Dwyka beds and the older rocks comes out well on Sheet 50, and in Sheet 42 we reach a district near Kimberley where the striated surfaces due to Permian ice are admirably seen in the field. The Twelfth Annual Report of the Commission, for 1907 (1908), by Dr. A. W. Rogers and Mr. Du Toit, describes much of the area of the maps with characteristic clearness. An interesting example of "pillow lava," a much discussed type of flow, is described

on p. 66. The superficial deposits of the dry region include much calcareous tufa, and recent quartzites appear as we go westward into the genuine desert.

Prof. T. W. Edgeworth David has issued the first part of his description of "The Hunter River Coal Measures, New South Wales" (Mem. Geol. Survey, N.S.W., 1907, price 12*s.* 6*d.*). This memoir, forming a handsome quarto volume, explains the numerous coloured maps and sections that have been published under a separate cover. The plates will interest the practical miner as well as the geologist. The sedimentary rocks and typical fossils are here excellently illustrated. The limits of the Australian Permo-Carboniferous system are discussed (p. 311); glacial beds, 200 feet thick (p. 321), occur in the Lower Marine series, and ice-borne erratics have been dropped into the Upper Marine muds, which are indented by them (p. 197 and Plate xxiv.).

The New Zealand Geological Survey, in Bulletin No. 4 (1907), by Messrs. C. Fraser and J. H. Adams, describes the geology of the Coromandel subdivision, Auckland. This area includes the oldest goldfield in New Zealand, which is at present not particularly flourishing. The Hauraki mine, however, must have amply rewarded its original shareholders. The veins containing gold and silver, whether in the Jurassic and older sediments or in the Cainozoic andesites, are connected with the extrusion of the latter (p. 98). The bulletin is as finely illustrated as its predecessors, and many of the plates are of interest to petrographers, full attention being given to sedimentary as well as igneous rocks. The price of the volume, including four coloured maps in a pocket at the end, is 2*s.* 6*d.*, a sum that is in keeping with the liberality of colonial Governments in these matters.

Bulletin No. 5 (1908), by Mr. James Park, on the geology of the Cromwell subdivision, forms an equally handsome volume, and contains some interesting details as to the distribution of gold-bearing material by glacial action. No natural sorting out of the gold occurs in moraines, which thus are less satisfactory than ordinary pockets in alluvium.

The Annual Report of the Geological Survey of Canada for 1904 was issued in 1906, but did not reach us until the present year. Bound up with it are several separately paged papers, including reports by Mr. Keele and Mr. Camsell on rivers in Yukon, and by Dr. G. A. Young on Mount Yamaska, in Quebec. The Yamaska mass affords a study in igneous differentiation, with basic "yamaskite" in the centre, graduating outwards into "essexite," and then into "akerite," with nearly 60 per cent. of silica. The Summary Report of the same survey for 1906 appeared in 1907, and shows the wide range of the work, attention being especially directed to mineral resources and to the economic possibilities of new routes opened across the country. Mr. W. W. Leach's separately printed paper on the Telkwa River and vicinity, British Columbia (Geol. Surv. Canada, Ottawa, 1907), shows the pioneer work that falls to the geologist, side by side with the miner, in this great Dominion.

Since our last article on "Geological Work in the United States" (NATURE, vol. lxxviii., p. 282), we have received the annual report of the Geological Survey of New Jersey for 1907 (Trenton, 1908), and vol. vi. of the Maryland Geological Survey, dated 1906. The former is distributed for the cost of postage, and includes an interesting and surprisingly direct warning to would-be investors (p. 15) against speculators in the Portland cement industry. Mr. J. V. Lewis has written on the petrography of the Newark igneous rocks. His memoir (pp. 96–168 of the report), which is very fully illustrated, contains a description of certain inclusions of arkose in diabase (p. 134), which have assumed the composition and partly the structure of augite-granite. The green augite present has been probably derived from the igneous invader, but the defects of any chemical classification of rocks are emphasised more than ever when we learn that one of these altered masses should fall into the "dosodic subrang of the rang *alaskase*," and another into the "presodic subrang of the rang *dacase*." When Mr. Lewis shows us the origin of these rocks in the field, such nomenclature appears as a mere learned trifling. The basaltic lavas of the Watchung area are admirably described, and their zeolites are attributed to the action of "juvenile" waters during the cooling of the flows. The Maryland volume is, as usual, very handsome, but far too heavy for the hand. The whole physiography of the State is dealt with, and a general account of its geological structure follows. The first 251 pages, covering also the soils and meteorology, form, indeed, a popular and exact guide for any educated citizen. Mr. E. B. Mathews contributes a history of the origin of the counties of Maryland, occupying more than 150 of these weighty pages; we must presume that this, like the reports of the highway surveyors, finds its most fitting place within the green covers of this well-known geological series.

The Annual Report of the Iowa Geological Survey for 1906 (1907) deals extensively with Portland cement and with the rocks quarried for economic purposes in the State. The analyses and tests of sedimentary building-stones have a petrographic as well as an engineering value, since these types of rock are apt to be neglected.

G. A. J. C.

THREE VOLUMES ON NORTH SEA FISHERY INVESTIGATION.[1]

THE first of the volumes referred to below reports a meeting of the International Council named, held in London last year, and also contains accounts of numerous researches. Both parts possess features of, in some respects, unusual interest, to only a few of which reference can be made in the present brief notice. The meeting was memorable as the occasion of some remarks made by Earl Grey in the course of an address of welcome, which made it clear that the British Government intended to continue to support marine research in the interest of the fisheries, and looked favourably on international co-operation in the matter. Since the conference a committee has been appointed by the Treasury to inquire into the prosecution of such researches, has heard evidence, deliberated, and lately has made its recommendations, which include plans for the organisation of the work. There seems, therefore, every probability of British fishery research being placed on a permanent basis, and an opportunity has obviously occurred which, if wisely dealt with, may result in an important step in the application of biology to industry.

Another interesting announcement was that of Commander Drechsel, who stated that a convention had been arranged between Sweden and Denmark which would prevent the landing in these countries of undersized fish from the Kattegat, including its extra-territorial waters. This convention is said to be due to the results of research. The results in question appear to be embodied in the "Summary Report on the State of our Knowledge with Regard to Plaice and Plaice Fisheries," by Petersen, Garstang, and Kyle.

This summary, which is as able as it is concise, was prepared in response to a request of the Dutch and Danish Governments. It deals with very varied studies, and is backed by a formidable array of seventy-four tables. It recommends legislation against the landing of small plaice from the Kattegat, because these small fish are not fatally injured by the methods of fishing there employed, rarely leave the district, and increase in value with growth to an extent which amply compensates the fishery for their loss as small fish. The conditions in the North Sea are felt to be more complex, and for this area no legislation is recommended, though the report favours the transplantation of plaice to good feeding-grounds. An apparent discrepancy between the estimates of intensity of fishing and of its effects calls for mention. The intensity of fishing in the Kattegat is held to be greater than in the North Sea; yet while the evidence (described as "not large") points to a lowering of the average length of North Sea plaice, the weight per score of Kattegat plaice of above 25·6 cm. length is not declining (Table III.). If North Sea fishing kills off the large plaice more quickly than nature replaces them, *a fortiori* the largest Kattegat

[1] (1) "Rapports et Procès verbaux des Reunions. Conseil permanent international pour l'Exploration de la Mer." Vol. vii. Pp. xxxviii+314.
(2) *Ibid.*, vol. viii. Pp. 125; plates 12.
(3) "Bulletins trimestriel des Résultats acquis pendant les Croisières périodiques." Année 1906–7. No. 3. Pp. 33–95; plates 9.

plaice should disappear. Of course it is theoretically possible that average length should decline without average weight, owing to the reduced competition for food attending a thinning of the population—though in that case the utility of a size-limit is not obvious—but in all probability the discrepancy is due to paucity of data in one or the other of the areas, and will disappear with the collection of more information. The point does, however, emphasise the importance of testing the adequacy of samples of fish used for statistical purposes, a matter which is dealt with in another paper of the volume on the Ymuiden plaice measurements.

The secretary concludes his official record of the conference with a reference to the reception of the council by the King, and with pleasant, if a little quaint, expressions of thanks to the institutions and gentlemen who constituted themselves hosts, and to the clubs which "opened their hospitable localities" to the members.

The second volume before us is devoted to the seals of northern Europe. The material used was collected by Hjort and Knipowitsch, and is of the most diverse character, ranging from zoological literature to the journals of sealing vessels. The intention in dealing with this data was to give accounts of the biology, economic value, and influence on fisheries of seals, and to arrive at conclusions on the question of their extermination. The first of these purposes is admirably carried out by Dr. Wollebæk in a paper well illustrated by charts and plates, the account of the distribution and migrations of the seals being especially interesting. The report is in two parts, a Norwegian and a Russian, and it is evident that the value attached to sealing by the Russians prevents their sympathising greatly with Norwegian projects for the extermination of these animals. The charges against the seals are that *Phoca vitulina* damages the salmon fisheries, which is generally admitted, and that *P. groenlandica*, *P. foetida*, and *P. vitulina* also damage the fishery for the cod which follow the "Lodde" (*Mallotus villosus*) to the coast of Finmark, in exceptional years causing its complete failure. The damage done by hordes of fish-eating seals in the exceptional "seal" years, such as 1902–3, must be very great; yet the report would undoubtedly have gained in value had more attention been paid to the admitted possibility that the exceptional conditions which brought the seals also drove off the fish. The hydrographic conditions of the years in question were so exceptional that they may well have determined the failure of the fisheries; yet they receive but brief recognition, and the resulting impression is somewhat that of a trial confined to speeches for the prosecution. One feels that, were the seals eliminated, the Lodde fishery would possibly still be liable to sudden failure.

The third publication under notice is one of a series issued at fairly regular intervals, and contains the detailed hydrographic and plankton observations made by the vessels employed in the international researches during the first quarter of 1907, together with illustrative charts and sections. The periodic preparation of these bulletins must be a severe tax on the time and energies of the workers, but the resulting records should be of great utility to those studying the North Sea and English Channel.

THE DAWN OF METEOROLOGY.[1]

METEOROLOGY as a science is young, but as a branch of knowledge very old, perhaps as old as mankind. Indeed, the beginnings of meteorology are to be found with the origin of human civilisation. In those remote times, man living as hunter or agriculturist mostly in the open air was more influenced by, and more depending on, the weather than we are ourselves at present, and he was therefore forced to watch atmospheric phenomena. He did so, of course, not in order to study the atmosphere and to discover its laws, but to derive immediate advantages for himself. He was anxious to learn how to protect his house against the inclemency of the weather, how to foresee the best atmospheric conditions for his undertakings, or how to find out the most favourable climatic situations for his fields.

[1] Abridged from a lecture delivered before the Royal Meteorological Society by Prof. G. Hellmann, and printed in the Quarterly Journal of the Society, October, 1908.

The experience of the more intelligent men in this respect was handed down, and at the same time augmented, from generation to generation, and formed very early an essential element in the knowledge of the people.

It was the popular weather-wisdom which is still living nowadays, and will never die. This weather knowledge soon assumed the form of short proverbs, or rather absolute rules, because thus they were easily committed to memory.

It would, therefore, be wrong to imagine that the rich store of weather-lore found in the Bible, especially in the Book of Job, in the poems of Homer and Hesiod, that is, in writings of the eighth century B.C., originated then in Palestine or Greece. On the contrary, the familiarity of the people with the sayings and rules concerning the weather, revealed to us by these writings, shows clearly that they must be considered even then as a primeval stock of culture. Indeed, there is every reason to believe that the origin of a great deal even of the modern weather-lore can be traced to its Indo-Germanic source.

People attribute a good deal of prognostic signification to the so-called "twelve nights" (or "twelve days"), which formerly were counted from the beginning of the year, but later, under the influence of the Christian Church, from Christmas. People believe that the weather of these twelve nights (or days) corresponds with that of the twelve months of the following year—indeed, a rather simple forecast of long range if it were true! This superstition is met in the whole of European literature back to the fifteenth century, and still earlier in many MSS. Also the Venerable Bede mentions it; and the Byzantine-Greek work on agriculture, called "Geoponica," which was collected in the sixth century A.D., tells us that even Democritus, in the fifth century B.C., was familiar with it in pretty much the same form. On the other hand, we learn from the Sanskritists that the old Indian or Vedic texts reveal the same belief in the twelve nights as a symbol of the following twelve months. But this superstition not only spread westwards with the Indo-Germanic race, it migrated also eastwards to China, where on New Year's Day a custom is still in use which is based on the same Indo-Germanic conception.

Another superstition concerning the weather leads us to old Babylonia. Many European chapbooks of past centuries, and a little Swedish book, "Sibyllæ Prophetia," which is sold to-day at fairs, contain forecasts of the weather and fertility of the whole year deduced from the thunder heard in each of the twelve months. These *signa tonitrui* can be followed up in MSS. until the Middle Ages, and go back apparently to the rich literature of thunder-almanacs or brontologies, in the composition of which in the fourth and fifth centuries even Byzantine emperors have taken part. In a similar chapter of the already cited Greek book "Geoponica" this doctrine is attributed to Zoroaster. Though this may not be the real author, yet his name indicates its Oriental origin; and, indeed, I found in the works of the Assyriologists—Sayce at Oxford and Lénormant in Paris—some translations of cuneiform tablets proving the Chaldaic origin of this superstition concerning thunder.

The state of meteorology in the old Babylonian culture, namely, three to one thousand years B.C., shows quite another character than it did in those primeval times in which the weather proverbs originated.

After having been formed into the beginnings of a learned profession by the priests, the atmospheric phenomena were brought by them into connection with the constellations of the heavenly bodies, and a complete system of consequences and combinations was established which gave rise to the astro-meteorology. It even formed an integral part of the Assyric-Babylonian religion.

The meteorological observations of the Chaldeans were apparently of a quite selective nature, referring above all to optical phenomena, especially to the halos. They distinguished clearly the small halo of 22° diameter, called "tarbasu," from the greater one of 45°, called "supuru." Besides, they paid much attention to clouds, winds, storms, and thunder; but a good many of these observations served more for a general prophecy of good and bad things, or omens, than for the forecast of the weather.

No meteorological theory has yet been discovered in the Babylonian tablets, of which, of course, only a small number has been preserved, and even a smaller number deciphered. But I was quite recently greatly surprised to find that the Babylonians had the windrose of eight rhumbs, and used already the names of the four cardinal points to denominate the intermediate directions; whereas it was until now generally supposed that we owe to Charles the Great, or perhaps to his learned monk Alcuin, who came from Yorkshire, this progress of the combination of the four principal winds to denote all others. That was indeed a great advance, for it is well known that in the Greek and Roman periods each wind had its peculiar name,

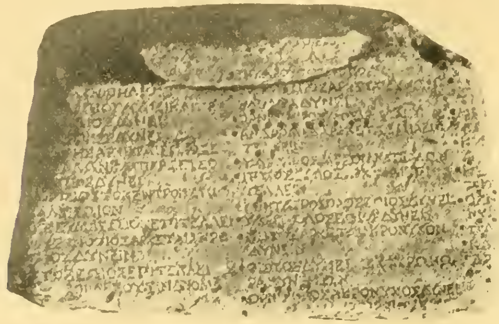

FIG. 1.—Fragment of Parapegma.

a practice still in use amongst the Italian mariners in the Mediterranean.

From the Babylonians to the Greeks is a far cry, but there is also great progress from a meteorological point of view. It seems that the Greeks were the first to make regular meteorological observations, some results of which are still preserved, and that their great capacity for pure science induced them to establish meteorological theories.

My first statement is not only proved by Theophrastus, who quotes several men in Asia Minor and Greece making meteorological observations, but also by the interesting fact that since the time of Meton, namely, since the fifth century B.C., in the so-called *parapegmata* (παραπήγματα), a kind of peg almanac fixed on public columns, the general data of the weather resulting from observations were exhibited. As these weather-almanacs differed from town to town, it clearly follows that they were based on individual observations made in each district.

Here is an example taken from the *parapegma* of Geminos, whose book, entitled "Introduction to the Phenomena," is of special value for this question:—

August 31.—The shoulders of Virgo are rising. The winds called ἐτησίαι cease to blow.

September 5.—Rising of Arcturus. South wind, rain, and thunder.

September 12.—The weather will likely change.

September 14.—Mostly fine weather for seven days, thereafter easterly winds.

Fig. 1 shows a fragment of such a *parapegma* found recently at Miletus, and now preserved in the museum at Berlin.

In the holes which can be seen in the marble stone little wooden pegs were put in order to fix the beginning of the year and the days, which gave rise to the name *parapegma*, derived from the Greek verb παραπηγνύναι = to fix into.

It is not surprising that in these *parapegmata* the observations of the wind prevail over all others, for they were of practical use to navigation and easily made. Also, the origin of the winds has always been a favourite subject of speculation among the Greek philosophers. In the epoch of Homer winds were still conceived as absolute beings like gods, whereas Anaximander of Ionia, who lived in the fifth century B.C., is the first to give a scientific definition of the wind, which is still valid. He says: ἄνεμον εἶναι ῥύσιν ἀέρος, the wind is a flowing of air.

It is therefore quite natural that the Greeks, even at this early period, used wind-vanes, which represent the older meteorological instrument, and a most interesting example of it is preserved in the "Tower of Winds" at Athens.

At the time of the construction of the tower, namely, in the first century B.C., a great many wind-vanes were already in use, for a contemporary Roman writer, Terentius Varro, tells us that in Roman villas they were constructed in such a manner as to show the direction of the vane on a windrose fixed to the ceiling of the room ("ut intus scire possis").

Soon after these earliest qualitative observations of the weather and direction of the wind we find the first quantitative ones, that is to say, the measurement of rain, in the first century A.D. It was made in Palestine, where the great influence of rainfall on the crops must have been fully appreciated at an early date, and the results of which observations are preserved in the Mishnah, a collection of Jewish religious books apart from the Bible. It seems to me most interesting to state that the amount of rainfall then considered as normal for a good crop corresponds pretty closely with that deduced from the modern observations made by Mr. Thomas Chaplin at Jerusalem, whence it can be inferred that the climate of Palestine has not changed.

Many of my audience will perhaps be astonished when I state that we are indebted also to antiquity for the first idea of a most important modern meteorological instrument. Most men of science are still of the opinion that antiquity achieved nothing concerning physical instruments and experiments; but the more we become acquainted with the scientific and technical literature of the Greeks and Romans, which at present is often the subject of study of philologists in preference to the classical authors, the more we learn their many positive results in this respect.

There are two physicists of special interest to us in this connection, namely, Philo of Byzantium, who lived in the third century B.C., and Hero of Alexandria, whose century is not yet settled, but who certainly lived after Philo and the great mathematician Archimedes, both being quoted by him. In the writings of these two physicists we find the description of an apparatus which represents the primitive idea of the thermoscope.

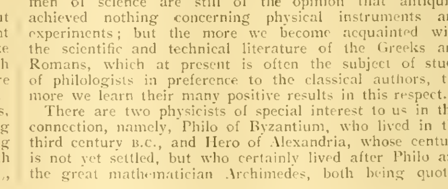

FIG. 2.

Philo's description in his work "De ingeniis spiritualibus" (on pressure engines), the Greek original of which is lost, only an Arabian and a Latin translation being preserved, will be made intelligible by Fig. 2. He says:—

"One takes a leaden globe of moderate size, the inside of which is empty and roomy. It must neither be too thin that it cannot easily burst, nor too heavy, but quite dry so that the experiment may succeed. Through an aperture in the top is passed a bent siphon reaching nearly

to the bottom. The other end of this siphon is passed into a vessel filled with water, also reaching nearly to the bottom, so that water may the more easily flow out. *a* is the globe, *b* the siphon, and *g* the vessel. I assert, when the globe is placed in the sun and becomes warm some of the air enclosed in the tube will pass out. This will be seen, since the air flows out of the tube into the water, setting it in motion and producing air-bubbles, one after the other. If the globe is placed in the shadow or any other place where the sun does not penetrate, then the water will rise through the tube flowing into the globe. If the globe is again placed in the sun the water will return to the vessel, and *vice versâ*. . . . . The same effect is produced if one heats the globe with fire or pours hot water over it. . . ."

Somewhat more complicated is the similar apparatus of Hero, to which he gives the name λιβάς, or drip (Fig. 3).

Now it happened that this book of Hero on pneumatics, which must have been widely distributed already in MS., was translated in the eighteen years between 1575 and 1592 no less than twice into Latin and three times into Italian. It was studied by Galileo, Porta, and Drebbel, and gave, about the year 1600, to all three men the idea of constructing a thermoscope, and to the last one also the impulse of making an experiment on the origin of the winds. From this it appears there is an interesting

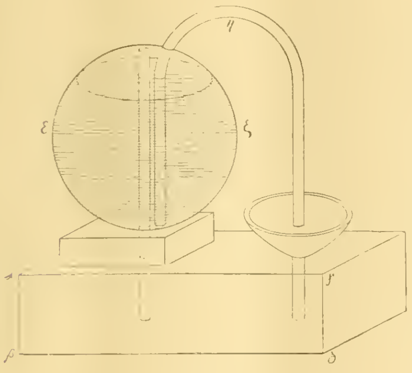

FIG. 3.

connection between the science of two remote periods with an interval of time of more than 1800 years!

As I said before, the Greeks were also the first to start theories of meteorological phenomena. Indeed, since the time of the oldest philosophical school, that of Ionia, there are few Greek philosophers who were not interested in some branch of meteorology. This covered a wider field of research then than at present, embracing, besides meteorology in the modern sense, also a good deal of physical geography and astronomy, especially shooting-stars, meteors, and comets. The favourite meteorological subjects of speculation and research seem to have been the origin of the winds, the theory of the rain, including the regular inundation of the Nile, and the rainbow. A good many cosmological speculations were also put forward by the meteorologists which often proved false, and, considered from a practical point of view, in all cases rather useless, whence in the period of Socrates meteorology itself came into disrepute.

But notwithstanding, meteorology made some real progress in time, and reached such perfection a century later that the system established by Aristotle remained for nearly two thousand years the standard text-book of our science. To be sure, considered from a modern point of view, Aristotle's meteorology was antiquated long ago, but if you imagine yourselves back in those old times you will agree with me that his treatise of meteorology—the earliest one existing is an excellent piece of work, and well worthy of the greatest systematiser of all times.

I should go too far if I were to analyse here the merits and demerits of Aristotle's meteorology. It may be sufficient to say that his most distinguished successors, such as Theophrastus and Posidonius, have added but little to the perfection of his system, which, on the contrary, gave rise to innumerable commentaries and paraphrases. All text-books of meteorology issued on the Continent until the end of the seventeenth century are exclusively based on Aristotle, whereas, curiously enough, in England his influence was much less. If I except Duns Scotus, I do not know any British scholar who has written a commentary on the meteorology of Aristotle, and even this one has quite recently been disputed. It is true the number of treatises on meteorology published in Great Britain before 1700 is unusually small compared with that issued contemporaneously in Germany, Italy, and France, in Latin or the vernacular language. Englishmen seem always to have been more inclined to make actual observations of the weather than to theorise upon it and to write systematic treatises on meteorology.

Among the Romans meteorology made but little progress, like all other sciences of no immediate practical value. Pliny, Seneca, and Lucretius do not add any remarkable fact or theory to the knowledge of the Greeks, and probably the same can be said of the lost writings of Nigidius Figulus and Suetonius Tranquillus. From Virgil we learn some new weather-proverbs originating in Italy, and a writer on agriculture, Columella, who owned a large estate near Cadiz in Andalusia, has left behind a "Calendarium Rusticum," or rural calendar, with many interesting weather observations made in that district.

The extensive colonial possessions of the Romans were, of course, suitable for advancing the conceptions of climatological differences of the countries. As the great military expedition of Alexander the Great to inner Asia and India had brought to the Greeks the first knowledge of the monsoon winds, so the Romans were the first to point out the difference between the continental and maritime climate. Minucius Felix, a Christian writer from Africa, living in the second century A.D., says, concerning the climate of Great Britain, "Britannia sole deficitur, sed circumfluentis maris tepore recreatur," that is, freely translated, "Britain has little sunshine, but a mild climate on account of the warm sea-water flowing round it."

The barbarous state of Europe after the fall of the Western Empire was not adapted to the furthering of science, which was barely kept alive within the Christian Church. Yet the pursuit of meteorology never wholly ceased, for the Fathers of the Church, writing commentaries on the work of the seven days, the so-called Hexaëmeron, often took occasion, when dealing with the first day of the Mosaic Creation, to insert long elaborations on the atmosphere and its phenomena.

At the very beginning of the Middle Ages the great encyclopædists, such as Isidorus Hispalensis in Spain, the Venerable Bede in Great Britain, and Rabanus Maurus in Germany, were the first to devote more attention to meteorological questions, the interest in which must have been considerable in England, for in the tenth century an extract of Bede's writings, concerning astronomy and meteorology, was made for the uninitiated in the Anglo-Saxon language, which is perhaps the earliest treatise on science written in a popular form. It contains chapters on the winds, rain, hail, snow, and thunder.

A general revival of studies took place at the end of the twelfth century, when the writings of Aristotle, among which was his "Meteorology," came to the knowledge of the Western students by Latin translations made in Spain from the Arabian ones, not from the Greek originals. The imposing meteorological system of the great Stagirite again exercised a great influence on the writings of the scholars and on the teaching in the recently established universities, where, under the title "Meteora," regular courses and even exercises in meteorology were held. Albertus Magnus at Cologne wrote at this time his great meteorological works ("De Meteoris," libri iv., and "De Passionibus Aeris"), paraphrasing chiefly those of Aristotle, but adding also the opinions of other authorities

and his own remarks; and at the same time, or somewhat later, Vincent de Beauvais in France, Thomas de Cantimpré in Belgium, Ristoro d'Arezzo in Italy, Bartholomew Anglicus (or de Glanvilla) in England, incorporated the Aristotelian ideas in their encyclopædic works all bearing the general title "On the Nature of Things" ("De Natura Rerum").

But the firm and absolute adherence to the doctrines of the master, Aristotle, the denying of all that could not be found in his writings, rendered the scholastic meteorology so noxious to any real progress that it came into conflict with all new ideas. Notwithstanding, these forced their way by and by, and the beginnings of the modern experimental science are to be found just at that epoch when scholasticism had reached its highest point, namely, in the thirteenth century.

It is not yet definitely settled where the new experimental science took its origin—most likely contemporaneously in France and in England, where the two friends Pierre de Maricourt (Petrus Peregrinus) and Roger Bacon can be considered as the first great representatives of the new aims.

The former, a French nobleman and military engineer, is the author of the famous treatise on the magnet, and made many optical experiments like his English friend; and although both have not dealt with meteorology properly speaking—except the rainbow—yet their general influence must have been great on our science also. Roger Bacon's energetic opposing of the experiment to the argument—"argumentum non sufficit, sed experientia," he says in his "Opus Majus"—conduced naturally to the observing of atmospheric phenomena instead of only interpreting the writings of the ancients.

Thus the new aims advanced meteorological observations also, for which the ground was well prepared. As I have just shown, such observations were made in antiquity and never had wholly ceased, despite frequent and long interruptions. For the custom of the Roman historians to note in their annals the more important atmospheric phenomena, especially those necessitating sacrifices, was handed down to the chroniclers of the Middle Ages, whose chronicles became richer and richer in entries of the weather, until at the end of the thirteenth century these records are so replete with remarks on the weather that the character of the seasons could be traced back.

Now the time is ripe for more systematic observations, and we find at Oxford William Merle, a fellow of Merton College, to whom remains the distinction of being the first man in the Occidental world to keep a regular journal of the weather day by day. It embraces the years 1337 until 1344. The journal is preserved at the Bodleian Library. It is the earliest known journal of the weather, kept at Oxford and later at Driby in Lincolnshire, where William Merle was rector.

A close examination of the circumstances forces me to the conclusion that William Merle was induced to make regular observations by the desire to ascertain the correctness of the prognostics made by himself and his colleagues at Oxford, where meteorology, or, more properly speaking, astro-meteorology, had been flourishing since the time of Robert Grosseteste, the famous Bishop of Lincoln. Merle himself has left behind two MSS. on the forecasting of the weather, and his contemporaneous fellow of Merton College, John Eschendon (or Ashendon), whose name has been corrupted into Eschuid, completed in 1348 a voluminous treatise of astro-meteorology bearing the title "Summa judicialis de accidentibus mundi." It was printed at Venice in 1489, and served in the sixteenth century as a text-book at the University of Vienna. The work is usually quoted in meteorological literature under the abbreviated title "Summa Anglicana," and is now extremely rare.

When, eighteen years ago, the journal of William Merle was re-discovered, it seemed to stand all alone, since we had no knowledge of other observations made in England or abroad; but recently I have been able to find out a nearly continued sequence of series of such observations, and to prove that from the fourteenth to the middle of the seventeenth centuries, namely, until the invention of meteorological instruments, the weather was regularly observed in many places in Central and Western Europe.

I had noticed that some copies of the large astronomical work, published in 1499 by Justus Stoeffler and Jacob Pflaum at Tubingen, "Almanach nova plurimis annis venturis inservientia," containing ephemerides for the years 1499 to 1531, were full of meteorological entries written on the broad margins. This induced me to make systematic inquiry into copies of the work named containing such entries preserved in the great libraries of Germany, Austria, and Switzerland. The result of this inquiry was rather astonishing. No fewer than 123 different series of meteorological observations belonging to the fifteenth, sixteenth, and seventeenth centuries were found. Considering that this number of necessity represents but a small proportion, and concerns only some parts of Central Europe, we may safely presume that in the whole of Europe their number must have been far greater. Some of these early series of weather observations are even corresponding ones, made by agreement.

A fresh stimulus for observing came at the end of the fifteenth century from quite another direction. The great discoveries of new lands and seas considerably enlarged and widened old ideas and conceptions. Atmospheric phenomena never seen before came to the knowledge of man, and climates very different from those at home became known. Intelligent men were struck by such varieties, and we can clearly observe their effect on them in the writings of that epoch. Luis de Camões, the famous Portuguese poet, described in his epos, "Os Lusiadas," for the first time minutely the water-spouts often observed by him off the coast of Guinea and the storms in the South Indian Ocean, while from the logbook kept by Christopher Columbus during his first voyage we learn the deep impression he got from the difference of climate and weather in the Atlantic beyond the Azores compared with that eastwards of the islands. Such new observations advanced mostly the doctrine of the winds, which was now more fully expounded in Spanish and Portuguese works, until in the year 1622 Francis Bacon was the first to publish a special treatise dealing entirely with the winds.

But meanwhile experimental science, the growing up of which I have just alluded to, was so much developed that in the first half of the seventeenth century the principal meteorological instruments were invented. To Italy belongs the glory of being the native country of instrumental meteorology, the cradle of which stood at Florence. These inventions proved the first step in making meteorology a science, and now the shadows of the dawn are fast disappearing before the full light of the rising sun.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Certain friends of the Chancellor desire the establishment of some award to be associated with Lord Rayleigh's name, in order to commemorate the unanimous election of a scientific investigator to the office of Chancellor of the University. With this object they have deposited a sum of money at the bank, the interest of which may be used for the purpose of awarding from time to time a prize to be called the Rayleigh prize. It is proposed to adjudicate these prizes at the same time and by the same adjudicators as the Smith's prize.

The Walsingham medal for 1908 has been awarded to C. C. Dobell for his essay entitled (1) "Protista Parasitic in Frogs and Toads," (2) "Chromidia and the Binuclearity Hypotheses"; and a second Walsingham medal to G. R. Mines and D. Thoday. Mr. Mines's essay was entitled "The Spontaneous Movements of Amphibian Muscles in Saline Solutions," and Mr. Thoday's essay was entitled "Increase of Dry Weight as a Measure of Assimilation." Lord Walsingham has expressed his willingness to give, this year, a bronze replica of the medal to each of the candidates awarded the second medal. The medal is awarded for a monograph or essay giving evidence of original research on any botanical, geological, or zoological subject, zoology being understood to include animal morphology and physiology. Essays for the ensuing year are to be sent to the chairman of the special board for biology and geology (Prof. Langley, The Museums) not later than October 10, 1909.

Mr. W. E. Dixon has been appointed university lecturer in pharmacology.

The office of superintendent of the museum of zoology will be vacant on January 15, 1909, by the resignation of Dr. Harmer. The stipend at present attached to the office is 200*l.* per annum. Applications should be sent to the chairman of the special board for biology and geology (Prof. Langley, The Museums) on or before January 21, 1909.

London.—Prof. A. Sedgwick, F.R.S., professor of zoology and comparative anatomy in the University of Cambridge, has accepted the professorship of zoology at the Imperial College of Science and Technology, South Kensington.

At a meeting on December 2 the Senate decided unanimously in favour of the appointment of a Royal Commission to consider the relations between the University and the Imperial College. It will be remembered that Mr. McKenna undertook to recommend the appointment of a Royal Commission if he received representations on the subject from the Senate of the University.

Mr. Lewis F. Day will give an address at the Sir John Cass Technical Institute at the distribution of prizes and certificates on Wednesday, December 16. There will be an exhibition of students' work and apparatus in the laboratories, workshops, and other rooms.

Mr. S. A. Saunder, secretary to the Royal Astronomical Society and a past-president of the British Astronomical Association, has been appointed to the Gresham lectureship on astronomy at Gresham College, London, rendered vacant by the resignation of the Rev. E. Ledger.

It is officially announced that letters patent have passed the Great Seal of Ireland constituting and founding a university, having its seat in Dublin, under the name of the National University of Ireland, and a university, having its seat in Belfast, under the name of the Queen's University of Belfast.

Speaking at Abergavenny on December 4, Sir Edward Strachey, M.P., commented upon the recently issued report of the Departmental Committee which inquired into the provision of education in England and Wales for affording scientific and technical instruction in agriculture. Sir Edward Strachey asked, Why should there not be in this country a great State agricultural farm equipped with everything necessary for experiments and research and for the education of teachers in agriculture? There might well be in every county or group of counties an agricultural county farm subsidised by the State and, to a certain extent, from the rates. These farm institutions should be, he said, for assisting farmers and demonstrating the value of science applied to agriculture. There should be, too, a centre for experiments wherever local experiment is necessary, and for demonstration where desirable; but the best form of demonstration, he pointed out, is on various farms under different conditions of soils and climates. Sir Edward Strachey added that his suggestions were those of one who is a farmer, but that it is the duty of the President of the Board of Agriculture to formulate a scheme of national agricultural education somewhat on the Irish lines.

The report of the departmental committee on agricultural education is under consideration in detail by a committee of the Farmers' Club. A memorandum dealing with its several provisions is being prepared, and the committee has expressed agreement with the views stated in the report in the following resolutions:—(1) That the funds at present available for agricultural education are wholly inadequate, and considerably increased funds should be provided, the main source of which must be the national Exchequer. Such funds should be employed by the Board of Agriculture, first, to aid existing and projected institutions in respect of their staff and general equipment, and, secondly, to aid local authorities in making provision for the agricultural work conducted by them. (2) That since complete cooperation between the Board of Agriculture and Education is essential, if the field of education is to be adequately covered and overlapping avoided the committee is of opinion that agricultural instruction, when provided by universities, university colleges, agricultural colleges, farm institutes, and winter schools, or by means of special classes or courses of lectures in agriculture and kindred subjects (*e.g.* dairying, horticulture), should be under the direction of the Board of Agriculture, while all instruction in agricultural subjects forming part of courses in primary, secondary, or such evening schools as are in definite continuation of the education given in primary schools, should be under the Board of Education.

SOCIETIES AND ACADEMIES.

London.

Royal Society, November 5.—"On the Generation of a Luminous Glow in an Exhausted Receiver moving near an Electrostatic Field, and the Action of a Magnetic Field on the Glow so produced, the Residual Gases being Oxygen, Hydrogen, Neon, and Air." Part iii. By F. J. **Jervis-Smith**, F.R.S.

A silica bulb, as used in the experiments described in Proc. Roy. Soc., A, vol. lxxxi., p. 214, was rotated in a magnetic and also in an electrostatic field, the residual gas being oxygen. The inductor was charged until the bulb glowed; then it was slowly discharged through damped thread, until the glow disappeared; on establishing the magnetic field the brilliant glow was restored. The magnetic effect was less marked when air was the residual gas. When glass was employed instead of silica the glow was greatly reduced. The glow effects in widely differing gases were compared. Sir William Ramsay kindly prepared for the author of the paper a bulb in which the residual gas was neon. The neon glow-bulb when treated exactly in the same way as the oxygen glow-bulb gave but little glow, of a reddish tint. The glow was but feebly affected by the magnetic field. A silica glow-bulb, residual gas air, was rotated, as in the previous experiments; the inductor was charged to 800 volts, and placed at such a distance from the bulb that it did not show any glow. On establishing a *magnetic field*, in which the bulb rotated, it *glowed brightly*.

When hydrogen was the residual gas, in a glass bulb the position of maximum glow was shifted through 90° from the position of maximum glow when oxygen was the residual gas.

The effect of a magnetic field on the generation of electricity was examined. A silica glow-bulb in contact with a camel-hair brush was rotated between the poles of an electromagnet. The pressure of the brush was so adjusted that no glow was visible; when the magnetic field was established the bulb glowed brightly, and ceased the instant the magnetic field was shut off. The experiment could be easily repeated with certainty.

In another experiment the brush, after being in contact with the bulb, was removed. The bulb glowed the instant the magnetic field was restored. The experiments illustrate the profound change which takes place in the behaviour of a moving static induction of electricity when the bulb in which it occurs is in a magnetic field, and show how the action of the magnetic field on the electric motion in the residual gas is modified by the nature of the gas employed.

Royal Microscopical Society, November 18.—Mr. Conrad Beck, vice-president, in the chair.—A new growing cell for critical observations under the highest powers: A. A. C. E. **Merlin**.—Studeria, a remarkable new genus of Alcyonarians: Prof. J. A. **Thomson**.—The present status of micrometry: Dr. M. D. **Ewell**.

Entomological Society, November 18.—Mr. H. Rowland-Brown, vice-president, in the chair.—Descriptions of micro-lepidoptera from Bolivia and Peru: E. **Meyrick**.

Cambridge.

Philosophical Society, November 23.—Prof. Sedgwick president, in the chair.—The relationship between human and bovine tuberculosis: Prof. **Woodhead**. The author gave an account of some observations on 127 cases of tuberculosis in children. He found that the disease seldom occurred in children who died under one year of age, only

four out of 100 affected with mesenteric tuberculosis coming into this category; between the ages of two and 5½ years, however, sixty-two such cases occurred. This led him to look to the milk of tuberculous cows as a source of infection, as children below the age of twelve months seldom receive much milk except that from the mother—especially amongst the poorer classes—whilst from one to 5½ years milk usually forms some part, at any rate, of a very mixed diet. He mentioned the work of other observers, who have come to the conclusion that bovine tuberculosis may be the source of infection of children, especially of the alimentary canal. There could, of course, be no doubt that there were two (or more) types of tuberculosis, marked differences of virulence, of growth, &c., being observed, but he was satisfied that these differences were not specific, and that sometime or other we should be able to find links connecting the extremes.—The transmission of *Trypanosoma lewisi* by fleas and lice: Prof. **Nuttall.** The author described experiments which demonstrated that *Ceratophyllus fasciatus* and *Haematopinus spinulosus* are capable of transmitting *Trypanosoma lewisi.* In one experiment three fleas, transferred from a diseased to a healthy rat, gave a positive result. On the other hand, thirty to sixty lice were required for the transmission of the trypanosome. No signs of any development of the trypanosomes were observed in the bodies of the lice.—The presence of anticoagulin in the salivary glands of *Argas persicus*: Prof. **Nuttall.** Experiments conducted with Mr. C. Strickland have shown that the salivary glands and intestine of *Argas persicus* contain an anticoagulin which is inactivated by exposure to a temperature of 80° C. for ten minutes. The organs of the tick do not contain hæmolysins.—The mode of action of specific substances: W. E. **Dixon** and P. **Hamill.** Evidence was brought to show that drugs having a specific action on a definite tissue do not bring about that effect by chemical combination with protoplasm or with a constituent of the living cell. It was concluded that the mode of action of Galenical drugs was different from that of the hormones.

The action of specific substances in toxæmia: W. E. **Dixon** and W. H. **Harvey.** In this paper it was shown that certain toxins, such as that of diphtheria, cause death by vasomotor failure. It was found that in animals affected with such a toxæmia death can be greatly delayed by the injection of normal saline solution. The action of drugs becomes progressively less according to the degree of toxæmia; those drugs which act on the central nervous system are the first to lose their effect, and those which act on muscle-fibre retain their characteristic effect longest.—Therapeutic inoculation for generalised bacterial infections: L. **Noon.** Opsonic observations show that rabbits and guinea-pigs, with an experimental peritonitis due to the B.-pseudotuberculosis, do not react to the infection for the first five days or more. An inoculation of killed bacilli under the skin of a normal rabbit produces a good opsonic reaction within forty-eight hours. A similar inoculation in a rabbit already diseased calls forth a still more prompt reaction.—The examination of living leucocytes *in vitro*: C. **Ponder.** The satisfactory examination of leucocytes attended with many difficulties. A method described and demonstrated, whereby, with the aid of a new form of blood chamber, the leucocytes are allowed to escape from a clot of fresh blood, and as they adhere to the surface of a glass slide the clot can be washed away; the leucocytes can be kept alive some time, and their movements and other physical properties observed.—The mode of growth of bacteria: Dr. **Graham-Smith.**—The radiation of various spectral lines of neon, helium, and sodium in a magnetic field: J. E. **Purvis.** Photographic observations were made with Prof. Liveing's 21-feet Rowland grating, and eye observations with an echelon spectroscope in the case of neon. The strengths of the magnetic fields varied from 24,000 to 26,100 units. The general results were:—(1) the measured shifts of the lines of neon towards the red end of the spectrum; (2) the values of the divided constituents of the neon lines compared with those of Lohmann; (3) the difficulty in distinguishing the various constituents of the neon lines in the more complex phenomena observed by Lohmann with an echelon spectroscope; (4) the values of the separated constituents of various neon lines, of those of the sodium lines 5896 and 5890, and of the helium line 5875·6 were compared with those of Lohmann, Runge and Paschen, and Rayleigh.—Note on migration constants of dilute solutions of hydrochloric acid: C. **Chittock.** Measurements have been made of the migration constants of aqueous solutions of hydrochloric acid of varying concentration, by a method similar to that which was employed by Whetham and Paine (Proc. Roy. Soc., vol. lxxxi., A, p. 58) for solutions of sulphuric acid, with the object of throwing light on the cause of the abnormally low conductivity of dilute solutions of acids. The experiments show a considerable increase in the migration constant as the concentration is diminished. The bearing of these results on the question of the conductivity of acid solutions is discussed.—The effect of pressure on the ionisation produced by Röntgen rays in different gases and vapours: J. A. **Crowther.** The effect of pressure on the ionisation produced by Röntgen rays in different gases and vapours has been investigated for the cases of air, carbon dioxide, ethyl chloride, ethyl bromide, and methyl iodide, for pressures varying from atmospheric down to 1 mm. of mercury. In all cases (except for ethyl bromide at the higher pressures, where the effect of the penetrating secondary radiation already investigated was appreciable), the ionisation-pressure curve was found to be sensibly a straight line, even at the lowest pressures reached, and with the electrodes only 5 mm. apart. There was not in any case any indication of the presence of a perceptible amount of soft secondary radiation from the gas, the ionisation being apparently due, in the main, to the direct action of the primary rays.—The variation of the relative ionisation produced by Röntgen rays in different gases with the hardness of the rays: J. A. **Crowther.** Values have been obtained for the relative ionisation produced by Röntgen rays in various gases and vapours compared with air, for varying degrees of hardness of the primary rays. The results give no evidence of any approximation to a density law even for the hardest rays employed. For hydrogen and ethyl bromide the relative ionisation increases with the hardness of the rays; carbon dioxide, methyl acetate, and methyl iodide show a decrease.—Waves in a stream of viscous liquid: W. J. **Harrison.**

Dublin.

Royal Dublin Society, November 24.—Prof. Sydney Young, F.R.S., in the chair.—A new British bird, *Locustella certhiola,* and two birds, *Emberiza pusilla* and *Acrocephalus streperus,* new to Ireland, all killed striking Rockabill Lighthouse: R. M. **Barrington.** The author read a short paper on these birds, stating that Pallas's grasshopper warbler (*L. certhiola*), an eastern Asiatic species, is new to the British Isles, and that this is the second record of its occurrence in Europe. The little bunting (*E. pusilla*) and the reed warbler (*A. streperus*) are both new to the Irish avifauna.—Vitality, and the transmission of water through the wood of plants: Prof. H. H. **Dixon.** In this paper a comparative method is described for investigating the *rôle* played by vitality in the transmission of water. The results indicate that no sensible force is exerted by the cells of the wood on the transpiration current. The author also described some experiments and observations going to show that the fading of leaves on killed branches is due to stoppage of the conducting tracts and poisoning of the leaf-cells. With reference to the cohesion theory of the ascent of sap, the author pointed out that Berthelot's experiment, demonstrating the tensile strength of water as at least equivalent to 50 atmospheres, was made with water saturated with air, and not, as usually stated, with water deprived of air.—The origin of the Dexter-Kerry breed of cattle: Prof. J. **Wilson.** The author showed that the prevalent theory (first published in 1845 by Prof. Low in his "Domesticated Animals") that Dexter cattle were originated by a land agent called Dexter is untenable. The author then traced the migration of cattle first from the Continent to Britain, and then from Britain to Ireland, and showed that there were four possible breeds by which the native black cattle of Ireland were crossed and by which the Dexter breed might have been produced, viz. the Longhorns, the Shorthorns, the Herefords, and the Devons; but the first three of these

four breeds are ruled out, probably by time and geographical position, and certainly by size and colour. Had the Dexter been produced by any of these breeds it would have been larger, and it would also have carried some of their colour markings. The Devons, or at any rate red English cattle from the south-western counties, are thus left as the only possible progenitors of the Dexter, and the Mendelian explanation of the variations occurring when Dexters are bred with Dexters and Kerries confirms this view.

Royal Irish Academy, November 9.—Mr. J Ribton Garstin, vice-president, in the chair.—The gravitation stress of the æther: Prof. F. **Purser.** The author has endeavoured to solve the problem, first started by Maxwell, of accounting for the electrostatic or gravitation field by strains and corresponding stresses in the dielectric, or æther. Maxwell left this problem in an unsatisfactory condition, assigning, indeed, a condition of stress, but leaving the necessary corresponding strains unsatisfied. Subsequently it was shown that these strains were impossible in the case of a homogeneous isotropic æther in the gravitation problem, and the same would hold in the electrical. The author endeavours to extend this impossibility to a general Greenian æolotropic æther. It appears, therefore, necessary to start, as in other elastic problems, not from the state of stress, but from a state of strain, arranging this so as to give suitable stress conditions. This method is adopted by the writer (1) in discussing the gravitation stress due to the gravitation of matter confined to a certain sphere. This is approximately the problem of the æther stress due to the earth, a problem discussed by Maxwell. The results arrived at agree with Maxwell in giving a uniform pressure at the surface of the sphere. While, however, this pressure is with him independent of the constants of the æther, in the solution at present offered this pressure depends on the ratio λ/μ for the æther. If, then, we suppose the æther very nearly incompressible, *i.e.* μ/λ very small, we shall attain a comparatively small pressure in place of the 4000 tons per square inch of Maxwell. (2) The case of electricity on the surface of conductors in an electrostatic field is then considered. The stress in the dielectric now obtained is in general quite different from Maxwell's, notably where the point in the dielectric considered is at a great distance from the conductors compared with their linear dimensions and mutual distances. It agrees, however, with the Maxwellian stress in the fundamental requisites of (*a*) yielding no stress on a dielectric cell not containing a nucleus of free electricity; (*b*) giving the requisite electromotive force when it does contain such nucleus; (*c*) giving the requisite normal stress at the surface of conductors.

PARIS.

Academy of Sciences, November 30.—M. Bouchard in the chair.—Characters of the upper layer of the gaseous atmosphere of the sun: M. **Deslandres.** The results of a further study of the calcium line K_3 under a high dispersion are given, and deductions made regarding the circulation of the upper portions of the sun's atmosphere.—The metamorphosis of hydrocyanic glucosides during germination: L. **Guignard.** The seeds of *Phaseolus lunatus* were allowed to germinate both in daylight and in the dark, and the amounts of hydrocyanic acid obtainable from the seeds and the seedlings measured. From the experimental results the conclusion is drawn that if hydrocyanic acid is formed during germination by the action of the enzyme on the phaseolunatin, it disappears as soon as it is formed, entering into new combinations.—The total sugar of the blood: R. **Lépine** and M. **Boulud.** The virtual sugar of the blood is obtained by treating the blood clot with hydrofluoric acid. This acid possesses the advantage of causing less secondary action than the acids generally used for hydrolysis.—The perpetual secretary announced the death of M. Fliche, correspondant for the section of rural economy.—Study of the photographs of the Morehouse comet, 1908*c*, obtained at the Observatory of Juvisy: MM. **Baldet** and **Quénisset.** Ninety-six photographs of this comet have been taken between September 17 and November 6, two of which are reproduced in the present paper.—Conjugate networks with equal invariants: M. **Tzitzéica.**—The cyclid of Lie: A. **Demoulin.**—A method of M. Darboux: Leopold **Féjer.**—A class of linear differential equations of infinite order: T. **Lalesco.**—The Brownian motion and Einstein's formula: M. **Chaudesaignes.** Making use of spherical grains of gutta of known diameter, Einstein's formula has been fully confirmed as regards the influence of the radius, the time, and the viscosity.—The chlorides and oxychlorides of thorium: Ed. **Chauvenet.** The anhydrous chloride, $ThCl_4$, is more readily formed by the action of phosgene upon the oxide ThO_2 at a red heat. The hydrated chloride, even in acid solution, is readily converted into an oxychloride.—The action of antimony trichloride upon cobalt and on its alloys with antimony: F. **Ducelliez.** The antimonide CoSb is the only compound formed in this reaction.—The combinations of silicon and uranium. Uranium bisilicide, Si_2Ur: Ed. **Defacqz.** This substance is prepared by firing a mixture of aluminium, sulphur, silica, and uranium oxide. The silicide Si_2Ur is analogous to the silicides of tungsten and molybdenum already described.—The composition of the colloidal hydroxyferric chlorides, studied by filtration through collodion membranes: L. **Michel.**—A method of producing ethylene hydrocarbons, starting with esters: Albert **Colson.** Ethyl benzoate is split up into benzoic acid and ethylene when heated in sealed tubes to 310° C. or higher temperatures. Other benzoic esters give the corresponding olefines under the same conditions, and the esters of fatty and mineral acids behave similarly.—The addition of hydrogen to triphenylmethane: tri*cyclo*hexylmethane: Marcel **Godchot.** The Sabatier and Senderens reaction applied to triphenylmethane gives tri*cyclo*hexylmethane, the physical and chemical properties of which are given.—Observations on a note of M. L. Paris on the reproduction of the blue coloration of the Oriental sapphire: A. **Verneuil.** It is contended that the method of M. Paris does not give the true Oriental sapphire, and that this gem has not yet been reproduced artificially.—Gabbro and the iron ore of Joubrechkine Kamen (north Ural): Louis **Duparc.**—The comparison of the effects of serums with complex mineral contents and with saline water on the phenomena of excretion and nutrition: C. **Fleig.**—Normal chlorotropism in Bernhardus: Romuald **Minkiewicz.**—Sudden disturbances of sight associated with cerebral trouble: Pierre **Bonnier.**—The identification of the imprint of a blood-stained hand on a sheet: V. **Balthazard.** Reproductions of the blood stain and of the ordinary imprint of the hand of the suspected murderer are given. In spite of the difficulties caused by the texture of the sheet, the two imprints can be completely identified.—*Leucocytozoon piroplasmoides*, from epizootic lymphangitis of the horse: A. **Thiroux** and A. **Teppaz.**—The therapeutic value of hordenine sulphate: J. **Sabrazès** and G. **Guérive.** An account of the results obtained in the application of this base to the treatment of infantile diarrhœa, intestinal tuberculosis, muco-enteritis, enterocolotis, typhoid fever, and dyspepsia.—The biology of the bradypods: A. **Menegaux.**—Contribution to the geological history of the Neckar and the Main: Gabriel **Eisenmenger** and Mlle. J. **Duprat.**—Recent excavations carried out in the valley of the Somme: M. **Commont.**—The distribution of the levels and facies of the mesonummulitic in the Alps: Jean **Boussac.**—The discovery of *Elephas antiquus* at the island of Delos: L. **Cayeux.**—The density of sea-water at various points in the English Channel: A. **Letalle.**

NEW SOUTH WALES.

Linnean Society, October 28.—Mr. A. H. S. Lucas, president, in the chair.—Contribution to a further knowledge of Australian Oligochæta, part i.: E. J. **Goddard.** A new genus of fresh-water Oligochæta referable to the family Phreodrilidæ, represented by two species, is described. Individuals of both species are found associated with the large fresh-water crayfish, *Astacopsis serratus*, Shaw, one set dwelling among the eggs of the parasite, Temnocephala, the other set occurring in the grooves of the carapace. The conditions of habitat, the small number of known species, in conjunction with their geographical distribution, suggest that the Phreodrilidæ are the remnants of an old Antarctic stock, the modern representatives of which are now to be found under conditions

comparable with those of the stalked crinoids of the deep sea.—Some remarkable Australian Corduliinæ (Neuroptera: Odonata), with descriptions of new species: R. J. **Tillyard.** The paper deals with new or little-known Corduliinæ from northern Queensland. Three new genera are proposed:—Austrophya, allied to Cordulophya; Pseudocordulia, closely allied to Gomphomacromia; and Austrocordulia, allied to Syncordulia and the European Oxygastra. Five new species and the hitherto unknown male of the beautiful *Macromia tillyardi*, Martin, are described.—Notes on the geology of the north-west coast of Tasmania, from the River Tamar to Circular Head: T. **Stephens.** It seems probable that the basaltic sheets rising from the coast had their origin in fissure-eruptions along anticlinal axes, intervening folds being subsequently hollowed out by the erosion of rivers or by glaciers slowly moving northward along the lines of the present river valleys. With the exception of the fossils of the Tertiary beds near Table Cape, and the fossil wood from a breccia west of the River Leven, no evidence of any trace of organic remains in the rocks of the north-west coast has yet been placed on record.—Description of a new fruit-fly of the genus Dacus from New South Wales: D. W. **Coquillet.**

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 10.

ROYAL SOCIETY, at 4.30.—Reciprocal Innervation of Antagonistic Muscles. XIIth Note: Proprioceptive Reflexes. XIIIth Note: On the Antagonism between Reflex Inhibition and Reflex Excitation: Prof. C. S. Sherrington, F.R.S.—Electrolytes and Colloids. The Physical State of Gluten: Prof. T. B. Wood and W. B. Hardy, F.R.S.—On the Specific Heats of Air and CO_2 at Atmospheric Pressure by the Continuous Electric Method at 20° and 100 C.: W. F. G. Swann.—Potential Gradient in Glow Discharges from a Point to a Plane: J. W. Bispham.—The Extension of Cracks in an Isotropic Material: A. Mallock, F.R.S.—Results of Magnetic Observations at Stations on the Coasts of the British Isles, 1907: Commander L. Chetwynd, R.N.—The Rotation of the Electric Arc in a Radial Magnetic Field: J. Nicol.—On Anomalies in the Intensity in Diffracted Spectra: Dr. H. C. Pocklington, F.R.S.—The Isothermal Layer of the Atmosphere and Atmospheric Radiation: E. Gold.—A Comparison of the Radium Emanation Spectra obtained by Different Observers: T. Royds.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Output and Economy Limits of Dynamo Electric Machinery: J. C. Macfarlane and H. Burge. —*Probable Paper*: Commercial Electric Heating: J. Roberts.

ROYAL SOCIETY OF ARTS, at 4.30.—The Birds of India: Douglas Dewar.

MATHEMATICAL SOCIETY, at 5.30.—On the Propagation of Sound Waves Vertically in the Atmosphere: Prof. H. Lamb.—(1) On Sir William Rowan Hamilton's Fluctuating Functions; (2) On the Representation of a Function by Series of Bessel's Functions: Dr. E. W. Hobson.—Theory of Cauchy's Principal Values (Fourth Paper): G. H. Hardy.—Solution of a Problem of Mersenne's: Dr. T. Stuart.—Note on a Continued Fraction Equivalent to the Remainder after n Terms of Taylor's Series: Prof. L. J. Rogers.—Solid Angles and Potentials of Plane Discs: Balak Ram.—The Solution of the Homogeneous Linear Difference Equation of the Second Order: G. N. Watson.—On Differentials: Dr. W. H. Young.

FRIDAY, DECEMBER 11.

ROYAL ASTRONOMICAL SOCIETY, at 5.—An Improved Telescope Triple Object Glass: J. W. Gifford.—On the Determination of the Apparent Diameter of a Fixed Star: Major P. A. MacMahon.—Note on Spectral Class and Stellar Colour: Julia Bell.—Analysis of the Colours and Magnitudes of 3650 Stars between the North Pole and 25 South Declination: W. S. Franks.—A New "Cave Nebula" in Cepheus: Max Wolf.—On Some Points with Regard to the Light Fluctuations of Variable Stars: Karl Pearson.

PHYSICAL SOCIETY, at 7.—Exhibition of Electrical, Optical, and other Physical Apparatus.

MALACOLOGICAL SOCIETY, at 8.—On *Carelia pilsbryi*, n.sp.: E. R. Sykes. —The Radulæ of British Helicids, Pt. II.: Rev. E. W. Bowell.—New Species of Plectopylis: G. K. Gude.—A Preliminary List of Recent Middlesex Mollusca: J. E. Cowper and A. Loydell.—The Application of the Names Gomphina, Marcia, Hemitapes and Katelysia: A. J. Jukes-Browne.

MONDAY, DECEMBER 14.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Fifty Years of Nile Exploration and Some of its Results (The Jubilee of Speke's Discovery of the Victoria Nyanza): Sir William E. Garstin, G.C.M.G.

ROYAL SOCIETY OF ARTS, at 8.—Twenty Years' Progress in Explosives: Oscar Guttmann.

INSTITUTE OF ACTUARIES, at 5.—On a New Method of Constructing and of Graduating Mortality and other Tables: G. King.

TUESDAY, DECEMBER 15.

ZOOLOGICAL SOCIETY, at 8.30.—A Hunting-trip to Thian-Shan, illustrated by Lantern-slides: F. Gillett.—Some Notes on the Muscular and Visceral Anatomy of the Batrachian Genus Hemisus, with Notes on the Lymph Hearts of this and other Genera: F. E. Beddard.—Description of a New Species of Lacerta from Persia: G. A. Boulenger, F.R.S.—Remarks on Some Wart-hog Skulls in the British Museum: Dr. Einar Lonnberg.—On two Chinese Serow Skulls: R. Lydekker, F.R.S.—Warning Coloration in the Musteline Carnivora: R. I. Pocock.—On a New River-crab of the Genus Gecarcinucus, from New Guinea: Dr. W. T. Calman.—The Duke of Bedford's Exploration of Eastern Asia. XI., On Mammals from the Provinces of Shan-si and Shen-si, Northern China: Oldfield Thomas, F.R.S.

FARADAY SOCIETY, at 8.—The Redetermination of the Electrolytic Potentials of Silver and Thallium: Dr. F. J. Brislee.—The Heats of Combustion of Aluminium, Calcium, and Magnesium: F. E. Weston and H. R. Ellis.—The Formation of Graphite by the Interaction of Magnesium Powder and Carbonates: H. Russell Ellis.—Colloidal Barium Sulphate: Dr. E. Feilmann.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: The Rotherhithe Tunnel: E. H. Tabor.

ROYAL STATISTICAL SOCIETY, at 5.

WEDNESDAY, DECEMBER 16.

GEOLOGICAL SOCIETY, at 8.

ROYAL SOCIETY OF ARTS, at 8.—London Milk Supply from a Farmer's Point of View: Primrose McConnell.

ROYAL MICROSCOPICAL SOCIETY, at 8.—(1) A Workshop Microscope for the Examining of Opaque Objects; (2) A Simple Method of Illuminating Opaque Objects: J. E. Stead, F.R.S.—On Mounting Rotifers and Protista in Canada Balsam: Rev. E. Tozer.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Some Forms of Scientific Kites: E. S. Bruce.—(1) The Registering Balloon Ascents of July 27–August 1, 1908; (2) Balloon Observations at Ditcham, July 27–August 2, 1908: C. J. P. Cave.

THURSDAY, DECEMBER 17.

LINNEAN SOCIETY, at 8.—The Anomura of the Red Sea: W. Riddell.—Forms of Flowers in *Valeriana dioica*: R. P. Gregory.—Études sur les Cirrhipèdes du Cambridge Museum: Prof. A. Gruvel.—Rhynchota from the *Sealark* Expedition: W. L. Distant.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Electric Discharge and the Production of Nitric Acid: W. Cramp and B. Hoyle.

FRIDAY, DECEMBER 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Type-casting and Composing Machinery: L. A. Legros.

INSTITUTION OF CIVIL ENGINEERS, at 8.—High-power Water-turbines on Moderate Falls: R. Wolfenden.

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THE AUTOBIOGRAPHY OF A PRACTICAL PHILOSOPHER.

Memories of My Life. By Dr. Francis Galton, F.R.S. Pp. viii+339; with 7 illustrations. (London: Methuen and Co., n.d.) Price 10*s.* 6*d.* net.

THOSE who are interested in the history of the growth of science in this country and in the men who participated in its development will thank Dr. Galton for having provided them with a characteristic account of his own life and of his relations with three generations of men of thought and action. Although Dr. Galton has provided a *précis* wherein those who know something of the author and his deeds can read between the lines, a biographer is still needed who will portray to the world what manner of man he is. Probably many will feel that the autobiographer's "fear" is well grounded that he may "have failed through over omission."

That love of accuracy which runs through all his work appears on every page of the memories, dates are scattered with profusion, and the frequently recorded personal incidents will delight the heart of future bibliographers. The book contains two excellent portraits and a bibliography of the author's writings.

Very briefly, in a chapter on parentage, Dr. Galton indicates the origin of his hereditary tendencies, and the following four chapters narrate the influences of companions, school, and university which moulded his "status of pupilhood." His paternal grandfather was a statistician, and so was his father; as to his mother, it is only necessary to state she was a Darwin. To his progenitors he was indebted for "a considerable taste for science, for poetry, and for statistics; also, partly through the Barclay blood, a rather unusual power of enduring physical fatigue without harmful results," and, it may be added, certain of the qualities of the Quakers, though adhesion to the Society of Friends practically ceased with his grandfather's generation. On the whole he gained little from the schools he attended, and at the age of sixteen he took up his abode, as indoor pupil, in the Birmingham General Hospital; his early experiences and the ideas that occurred to him make interesting reading. Later he went to King's College, London, and enjoyed to the full the wider intellectual outlook and companionship of distinguished men. The passion for travel seized him in 1840, and he went to Giessen to study chemistry, but he played truant, and made an adventurous voyage down the Danube to the Black Sea. A visit to Constantinople and Smyrna fired his imagination. This little expedition proved to be an important factor in moulding his after-life; it vastly widened his views of humanity and civilisation, and confirmed his aspirations for travel. The first year at Trinity College, Cambridge, "was a period of general progress, without much of note." The reading parties in the long vacations and the later terms were full of the inspiriting influence of older and younger men who have left their mark on the intellectual history of Britain, and he points out "the enormous advantages offered by a university to those who care to profit by them." His health broke down in his third year, and it comes as a shock to learn that he was obliged to content himself with a poll degree; but this has since been made up to him by his university giving him an honorary degree of doctor in science (1895), and his college electing him to an honorary fellowship (1902).

The following seven years fall into three periods. A visit to Egypt, when he visited Khartum, went some distance up the White Nile, and had several journeys across the desert, was not the pleasure trip it is to-day. This was followed by a tour in Syria. Some four years were then spent at home, reading, hunting, and sailing; it was at this time he invented an apparatus, the telotype, for printing telegraphic messages.

In 1850 he fitted out an expedition to a portion of south-west Africa which was then absolutely unexplored. The results of this noteworthy expedition were published in "Tropical South Africa" (1853), and laid the basis of our present knowledge of the country and people of Damaraland. Recognition followed this hazardous and fruitful enterprise in the bestowal of the gold medal of the Royal Geographical Society, the fellowship of the Royal Society, and the membership of the Athenæum Club. A further result of this experience was the publication of that eminently practical book, "The Art of Travel," which is replete with common sense. Dr. Galton for many years served on the council of the Royal Geographical Society, and was intimately connected with the expeditions of the great African travellers Burton, Speke, Grant, Baker, and Livingstone. It was due to his initiative that the society interested itself in geographical education at first in public schools and latterly in the Universities of Oxford and Cambridge.

In 1853 Dr. Galton married and settled in London. Then began a life full of intellectual activity which has persisted to the present moment; various tours were taken in Britain and on the Continent, and a passion for mountaineering was developed, but no extended expedition was attempted. Dr. Galton early became a member of the managing committee of the Kew Observatory, then the central magnetic observatory of the world; he became chairman in 1889, and held that post until 1901, when the observatory ceased to be an independent body; now it is merged into the National Physical Laboratory. The peculiar inventive genius of Dr. Galton here had full scope, and he busied himself with standardising sextants, thermometers, and other instruments of precision. His interest in the movements of the air led him to map out the data. He was the first to recognise the downrush of air associated with a high barometer and a clear sky, with an outflow having a clock-ways twist which is the exact opposite of a cyclone and supplementary to it. He named this system an "anti-cyclone."

Always interested in the problems of heredity, Dr. Galton has devoted the best years of his life to a study of heritability in man, as the following land-

marks testify: "Hereditary Genius" (1869), "English Men of Science" (1874), "Human Faculty" (1883), "Natural Inheritance" (1889), and his later writings on eugenics. Impressed with the necessity of obtaining a multitude of exact measurements relating to every measurable faculty of body or mind for two generations at least, he first stimulated schoolmasters to weigh and measure their boys, and established an anthropometric laboratory at the International Exhibition of 1884, and subsequently at South Kensington, several of the instruments employed being designed by him. These have formed the model of similar laboratories elsewhere. It was in this connection that he made an exhaustive study of fingerprints as a means of identifying persons, which led to the adoption of the system by the Criminal Departments of Britain, India, and many foreign countries; he also demonstrated that the patterns of the papillary ridges have no racial significance. Numerous experiments were made in composite photography, of which an interesting account is given. In order to ascertain the relative position of individuals, the well-known "centile" method was devised. As a side-issue he suggested the appropriateness of utilising the *median* vote in councils of juries. Being satisfied of the inheritance of mental qualities and that heredity was a far more powerful agent in human development than nurture, he endeavoured to ascertain the degree in which breeding might, at least theoretically, modify the human race. The general result of his inquiry was to support the view "that man is little more than a conscious machine, the slave of heredity and environment, the larger part, perhaps all, of whose actions are therefore predictable."

The strong practical bent that manifests itself in whatever Dr. Galton does constrained him to apply the conclusions to which his studies on human faculty and heredity had led him. Hence of late years he has occupied himself with eugenics, though so far back as 1865 he had formulated its leading principles, and he introduced the term in 1884. He thinks that "stern compulsion ought to be exerted to prevent the free propagation of the stock of those who are seriously afflicted by lunacy, feeble-mindedness, habitual criminality, and pauperism, but that is quite different from compulsory marriage. . . . A democracy cannot endure unless it be composed of able citizens; therefore it must in self-defence withstand the free introduction of degenerate stock. . . ."

The aim of eugenics is to check the birth-rate of the Unfit, and to promote the improvement of the race by furthering the productivity of the Fit by early marriages and healthful rearing of their children, and thereby "to replace Natural Selection by other processes that are more merciful and not less effective." In his last utterance on this subject (*cf.* NATURE, October 22, 1908, vol. lxxviii., p. 645) Dr. Galton gives practical suggestions for creating a public opinion; he rightly recognises the enormous influence wielded by social opinion among all races and classes of mankind, and he would direct this tremendous force towards a favourable consideration of eugenics, trusting that practical results would ensue to the great betterment of mankind.

This bald, epitomised sketch of the life and activities of Dr. Galton indicates the wide range of his interests and powers. The practical application of scientific principles seems to be always in his mind, never from the point of view of the patentee or exploiter, but invariably disinterestedly, and his eugenic investigations were fired by a burning zeal for the well-being of his fellow-men. The transparent honesty and naïveté of the man are revealed in these straightforward memories. Perhaps we are too close to him to be able to judge how great his life's work will loom when the history of the science of our day comes to be written, but his energy, enthusiasm and character have stimulated many during the past and the present generation, and when these qualities are associated with sound work accomplished and the promulgation of larger views of life and duty, we can confidently await the verdict of posterity.

A. C. HADDON.

AN INTRODUCTION TO THE STUDY OF NATURAL HISTORY.

Animal Life. By Dr. F. W. Gamble, F.R.S. Pp. xviii+305. (London: Smith, Elder and Co., 1908.) Price 6*s.* net.

THIS is a fascinating introduction to the study of animal life, marked by freshness of outlook, stimulating exposition, and vivid style. To Dr. Gamble—editor though he be of an austere "Practical Zoology"—animal life is "a pageant," "a moving spectacle," and his inquiry is kinetic throughout. What is all this bustle about, what are the leading motives, what are the ends achieved? In developing his subject he has proceeded by the use of three leading motives that differentiate animals from plants—movement, the acquisition of solid food, and the nervous control of response to changing order, and the three main problems the solutions of which he considers are the maintenance of self, the development of self, and the progress of the race, though he is careful to point out that the last is "rather a motive that possesses animals than is possessed by them." He begins by contrasting animal and plant life:—

"Mass, stationariness, and pliability—the notes of plant life—are replaced in animals by purposeful evasion, activity, and intractability."

Then the fulness of the earth and the abundance of the sea is his theme, and "the mighty gamut of the scale of being." But amid all the multitude of forms and endless variety of architecture there are only a few chief styles, the history of which is briefly sketched. The stage has not always had its present-day scenery and troup of players. There has been a rise and fall of races.

"Wave after wave of life has risen from the inexhaustible depths of nature, towered to a great height, and has then fallen; yet undelayed the onward movement continues."

Nothing could be better than the chapter on animal

locomotion, which is informative, stimulating, and beautiful. It is interesting to hear of the elbow-joint of the bat-fish, of the agile Malayan lizard that runs securely over the tops of grass shoots, and of the movement of the vanes on the grebe's foot, but it is even more profitable to be led from a few simple experiments with a pennyworth of mussels to some clear ideas in regard to cilia, and then to a recognition that all movement partakes of this mysterious innate character, self-caused and self-sustained. With admirable vividness and a frank enthusiasm, the author pourtrays the finish and unweariedness of animal movement, which increases in perfection as we ascend the scale of being and reaches its highest manifestation in the migration of birds.

But movement implies expenditure of energy, and that leads the author to discuss the varied quest for food—the vegetarian habit and the protection of plants against wholly destructive visitors, the probable origin of the carnivorous habit among marine animals, the stress of terrestrial life, and the three paths by which land animals have become carnivorous. But

"Life is a fire, now slow, now fierce, and therefore needs air as well as fuel. Changefulness is of the very essence of being, and all our rest is but hidden activity. . . . The fire was lighted long ago. The twinkling flames hidden in thought, patent in conduct, have come from the vestal lights of other generations. Every moment of restful or restless activity they maintain the transformation of our bodies. . . . Food is but the laid fuel; oxygen, that which fans it."

This is the beginning of a fine chapter on the breath of life—that is to say, on the comparative physiology of respiration, in which Dr. Gamble shows that evolution corresponds in great part with the successful quest for oxygen.

"Man himself carries in his ears an unmistakable sign of his gill-breathing, watery past, and of the depths he has left behind him."

Breakdown by oxygenation, re-construction by feeding, are the two emulating processes in animal organisms; there is "the downward pull of oxidation and the upward thrust of nutrition," and more and more we see how the trembling balance of life becomes steadied by firm central nervous control. Thus we are led to the seventh chapter, on the nervous and sensory system, which is very illuminating. "Every living thing is an old hand," and the nervous system is the seat of organic memory.

"Not only day and night, winter and summer, seedtime and harvest, set agoing the inward pendulum of animal life, but the life and death of their associates, the swing of the tides, all the great secular movements, beat with alternating force upon the receptive nervous tissue."

In another very interesting part of the chapter the habits of a shrimp and prawn are taken as an example of the way in which the conduct of these animals is built up out of responses to light, pressure, and taste. It is also shown that the stiffening of relatively simple responses into habit and tradition is a necessary prelude to advance in higher responses. Colour plays so large a part in the business of life that it is in accordance with the perspective of this volume that it should have a chapter to itself. It is a subject with which the author's experience has made him peculiarly well qualified to deal, and we cannot but express our admiration for the way in which he works out the thesis that

"the pigments of animals are older than the effect they produce, and that the old nutritive, purifying, and respiratory uses of colour are the basis for the more recently evolved protective, warning, or mimetic values of colouration."

The summing-up of the book is in the second last chapter, on the welfare of the race, of which the last chapter—on the life-histories of insects—is in greater part a series of illustrations.

"The endowments of the individual, which have at first sight such an appearance of being purely personal acquisitions and advantages, are in reality of racial value,"

and in the love of mates the higher animals

"gather all their gifts to pour them into the lap of the future." "The life of animals and of working men agrees in this, that, consciously or unconsciously, it is a strife to give their children the best chance. Their response to this spirit takes varied forms, but ultimately it is an answer to the same stimulus, and though it seems to arise within us, it is the spirit of a hive whose boundaries are not limited by the seen or tangible."

This book, the interesting contents of which we have hinted at, will delight all who read it, both those who know much and those who know little. It will charm with its style and with the wonders which it discloses. The illustrations, it should be noted, are fresh and interesting, being in great part photographs of specimens in the Manchester Museum. It will help students to organise their knowledge in the light of the general ideas which it expounds, and it will suggest observation and reflection. Sometimes, perhaps, the author is the least thing too exuberant, as when he says:—

"On our rocky coasts, from April to July, the puffin, the guillemot, and other spring migrants of the sea have made the rocks *musical with their chorus.*"

Sometimes, perhaps, the author's epigrammatic style makes a difficulty instead of removing one, for there is a little of the conundrum in a sentence like this:—"Soil is the remains of the vesture that waves in the wind and water, held in a meshwork of moulds," and many will be puzzled, not enlightened, by being told that "in man and creature colour is sacramental." But we have confidence in tendering to Dr. Gamble the thanks of thousands of students of animal life, who will find, or have found, in this book one of the most charming introductions to natural history, a book full of insight and suggestion, with a delightful *note personnel*, a contribution not only to science, but to literature.

J. A. T.

THE COMMERCIAL PRODUCTS OF INDIA.

The Commercial Products of India, being an abridgment of "The Dictionary of the Economic Products of India." By Sir George Watt. Published under the authority of H.M. Secretary of State for India in Council. Pp. viii+1189. (London: John Murray, 1908.) Price 16s. net.

IT is now almost a quarter of a century since the publication of Dr. (now Sir George) Watt's "Dictionary of the Economic Products of India" was commenced. That monumental work is now out of print, and the necessity for the issue of a new and revised edition has been evident for some time. The reissue of the complete Dictionary, however, is likely to be postponed for a good few years, so all the more do we welcome meanwhile the appearance of the present work, and we congratulate Sir George Watt on the completion of his three years' task.

As its subtitle indicates, the book is practically an abridgment of the Dictionary, published under the authority of His Majesty's Secretary of State for India in Council, and written mainly by Sir George Watt under the direction of a supervisory committee appointed by the Secretary of State. The scope of the work was to be "confined to products which are of present or prospective industrial or economic importance," and, on the whole, it has kept fairly well to those limits. The Dictionary consists of six volumes with a total of more than five thousand pages, while the present abridgment is in one volume of a little more than a thousand pages, well printed, and well got up. There is, of course, room for difference of opinion as to the importance or otherwise of some of the products discussed in the abridgment, but, in the main, excellent discrimination has been shown in their selection, for which, however, we understand the author is not responsible.

The articles themselves are modelled on the familiar lines of the Dictionary, and offer evidence of great industry in the consultation and quotation of all possible references, although with regard to the latter a stricter system of selection would have reduced the bulk without detracting from the value of the book. Uniformity of treatment of the heterogeneous items constituting a work of this kind is not, of course, feasible even if it were desirable, but this cannot be held entirely to excuse the uneven quality of the abridgment. Some of the articles give fairly succinct, business-like accounts of their respective subjects, as, for instance (amongst the longer articles), those on india-rubber or flax, and (amongst the shorter ones) those on *Calotropis gigantea*, *Dioscorea*, or *Pterocarpus*. Others, again, are unnecessarily spun out by failure to discriminate between essential and superfluous information and between proved facts and mere opinions not worth recording. The following examples illustrate this defect.

In the article on tea the historical part is padded with statements such as:—

"We read that Wang Meng, father-in-law of the Emperor in the middle of the fourth century was fond of drinking tea, and set it before his friends, but they found it too bitter, and generally declined, feigning indisposition."

Under *Acorus Calamus*, which, by the way, is scarcely an important product, we are informed that "Dr. Childe, second physician to the Sir Jamsetji Jijibhai Hospital, Bombay, tried an authentic tincture for malaria, dyspepsia, dysentery, and chronic bronchitis, and after careful experiment pronounced it inert." Again, in the article on Rhea, prominence is given to the fascinating effect on the author of the undying faith of a very old lady in the ultimate success of that distinctly doubtful crop.

We admit the difficulty of abridging a description in which one has also to incorporate the most recently acquired knowledge, but this difficulty should not necessitate the actual expansion of a dictionary article. Yet several of the articles in the abridgment are actually longer than the corresponding ones in the Dictionary. Thus in the Dictionary fifteen pages are devoted to *Boehmeria nivea*, and fourteen to *Camellia theifera*, while in the abridgment the number of pages are respectively sixteen and thirty-five.

We mention these defects from the point of view of one who hopes to have frequent occasion to consult the work, but dislikes the trouble of sifting the gold from the dross. Despite those blemishes, however, which we trust a more rigorous application of the blue pencil will cause to disappear in the next edition, there can be no question of the great value of Sir George Watt's book. He has laid a fresh debt of gratitude on all interested in India or its products by performing a work that very few but himself would have had the interest, industry, and patience necessary to accomplish.

A. T. GAGE.

THE PHYSICS OF EARTHQUAKES.

The Physics of Earthquake Phenomena. By Dr. C. G. Knott. Pp. xii+283. (Oxford: Clarendon Press, 1908.) Price 14s. net.

EARTHQUAKES, once regarded as portents and warnings to mankind, have become an object of human curiosity, and now form a branch of knowledge of which the principal external relations are threefold. They are of interest to the physicist, and their interpretation demands the application of the knowledge he has won; they interest the geologist as an explanation of, and as explained by, his observations of the structure of the earth; and they interest the man of commerce or affairs by their effect on man and on commerce and industry. With these varied outlooks it seems almost impossible that any one man should write a satisfactory handbook of seismology, and recent attempts leave much to be desired in their incomplete or inaccurate treatment of one or more branches of the science. Dr. Knott has confined himself to the physics of earthquakes, a department of their study with which he is well qualified to deal, and of which, more than of any other, an adequate text-book was required.

To a large extent the book deals with matters contained in other manuals, the treatment differing only

in form and more than usual correctness, and frequently in an unusual point of view. This is particularly noticeable in the chapters devoted to seismographs, which are refreshing in the absence of any polemical advocacy of one pattern of instrument or depreciation of another; there is little in the way of description of particular instruments or types of seismograph, and no attention is devoted to details of mechanical construction, which may vary according to the purpose of the instrument, but instead we have an impartial statement of the principles on which their construction is based and which control their action. The dynamics of the horizontal pendulum, which have been the subject of both mathematical and experimental investigation, are treated in a manner which makes them clear to anyone able to follow the simple mathematics used in the text, but it is unfortunate that Dr. Knott had not more mercy on those less mathematically disposed than himself, and expressed his numerical results in a form more immediately intelligible than that adopted by him.

This question of the behaviour of the horizontal pendulum in response to a periodic undulatory tilting, as opposed to its response to a static tilt, is one which has an important bearing on the design of seismographs; in most of these the design has been to eliminate resistance so far as possible, but there is another school which deliberately introduces a damping device of sufficient power to make the pendulum dead-beat or aperiodic, and it has been claimed that this damping renders the record accurate and capable of interpretation in terms of the displacement produced by a static tilt. Dr. Knott's figures show that this claim is unfounded. Where the period of the undulation is not less than three times that of the free swing of the pendulum, the amplitude of the record is within 10 per cent. of the displacement due to a static tilt of the same angle, the error being in excess in the case of the free and in defect in the case of the damped pendulum. When the period of the undulation approaches nearer to equality with that of the pendulum, the amplitude of the record increases largely in the case of the undamped pendulum and becomes diminished in the case of the damped pendulum, but in neither type is it possible to determine the true value of the angular tilt from the amplitude of the record. From this it will be seen that the result of a complete damping of the pendular swing is a diminution of sensitiveness of the instrument, and as it is only when the period of the undulation reaches three times that of the pendulum that either form gives a record capable of approximate interpretation in terms of the static tilt, there is no material difference in accuracy between the two when this limit is reached.

The periodicity of earthquakes is discussed at some length, with the general result that there is little evidence of the reality of any of the periods believed to have been established. We are not only in complete agreement with this conclusion, but would go even further than Dr. Knott in our distrust of the utility of applying the method of harmonic analysis to the discussion of effects the causes of which do not vary in a harmonic manner, and the method seems particularly inapplicable to the discussion of the effect of tide-producing stresses in the causation of earthquakes. The amount and direction of this stress, at any given instant and place, depend on the zenith distance, not on the hour angle, of the tide-producing body, and though these vary with each other, they do not vary in any uniform proportion. In these circumstances an harmonic analysis of the time of occurrence of earthquakes seems calculated to obscure rather than elucidate any direct effect of the tide-producing force, though it might reveal a tidal effect of a different nature.

For the rest the book is an adequate and clearly expressed treatment of the subject it professes to deal with. It cannot be described as easy reading, yet the difficulty lies entirely in the accuracy of its expression, and the consequent necessity for the frequent use of words unfamiliar except to the trained physicist, but anyone who is desirous of understanding, and will take the trouble to master the meaning of these unfamiliar terms, will find no difficulty in following the argument.

METHODS OF ACCURATE CALORIMETRY.

Méthodes de Calorimétrie usitées au Laboratoire thermique de l'Université de Moscou. By Profs. W. Louguinine and A. Schukarew. Translated from the Russian by G. T. Gazarian. Pp. iii+192. (Paris: A. Hermann; Genève: Georg et Cie., 1908.) Price 8 francs.

THIS volume by the well-known director of the thermal laboratory at Moscow University and his chief of staff does not claim to be a comprehensive treatise on all branches of calorimetric work, but, nevertheless, it will be welcomed as placing before a wider public the results of much valuable research hitherto comparatively unknown, especially in detail. Some of Prof. Louguinine's ingenious devices for carrying out accurate calorimetric investigations have been partly described in specialist treatises, but we have here complete descriptions, with full and clear working drawings, published, we believe, for the first time, except in their original Russian.

In calorimetry, perhaps to a greater extent than in most branches of physics, very much of the success attained in a particular experiment depends on attention to what might be considered small details. In our opinion, one of the most valuable features of the book is the large number of "wrinkles" or "tips" given by the writers from their own experience on just those points on which the ordinary books are silent.

The first chapter is an excellent discussion of the various types of thermometers used in calorimetry. The writers point out the absurdity of adhering to the German form of thermometer with milk-glass scale, carrying the graduations behind a thin capillary tube and enclosed in an outer sheath. Even if the milk-glass scale is fastened more or less by fusion at one or the other end of the tube, the type has many drawbacks, and would probably have been replaced long

ago by the solid-stem type of thermometer had it not been for the fact that it is nearly impossible to make clear fine divisions on the kind of glass of which these thermometers are usually made. The sensitiveness, length of degree, size of bulb, &c., of thermometers for calorimetric purposes are dealt with in detail, the authors' conclusions being closely in accord with the recommendations of the Bureau International des Poids et Mésures.

The chapter dealing with the "cooling correction" is specially valuable, particularly the clearly described way of graphically applying the Regnault-Pfaundler method.

In the chapter on specific-heat determination, Prof. Louguinine's tramway calorimeter is described. Details are given as to the curious fact, known to most who have worked at the subject, that it is extremely difficult in any form of vapour-heated vessel to arrange that the substance to be heated really reaches the temperature of the heating vapour employed, even if this be a vapour like steam, with a relatively enormous latent heat. A list of suitable substances for attaining various steady temperatures is also given.

An interesting chapter by Prof. Schukarew deals with some modifications of the Joly calorimeter, presenting some obvious advantages and giving increased precision.

In conclusion, we may say that the book is well got up, and the illustrations are numerous and excellent. A fault, however, is the large number of misprints and errata, many of which are not corrected in the list given at the end. It is startling to find many proper names, some those of leading authorities in the domain of heat—such as Bunsen, Velten, Callendar, Plattner, Wiedemann, Walferdin, Griffiths, and Dieterici—mis-spelt time after time.

J. A. HARKER.

TROPICAL AGRICULTURE.

Southern Agriculture. By F. S. Earle. Pp. vi+297. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.) Price 5*s.* net.

FOR many years there was a noteworthy dearth of books in English dealing generally with agricultural methods in the tropics and subtropics, and affording a concise summary of our knowledge of the plants of those regions. The information, it is true, was available in published form, but scattered in handbooks and pamphlets on particular plants and subjects, or buried in the files of numerous botanical and agricultural journals, so that those not actually engaged in the subject often found considerable and at times insuperable difficulties in obtaining a good, practical account of, for example, the principal fruits or the fibre-producing plants of warm countries.

To the still comparatively small series of books which supply such information, "Southern Agriculture," by F. S. Earle, is the latest addition. It does not profess to cover the whole range of tropical agriculture—which, indeed, would not be practicable in a volume of its size—but it so happens that the conditions in the southern States and the American possessions in the West Indies are so diverse, ranging from normal and arid subtropical regions to the thoroughly tropical West Indian islands, that the book will prove of utility to a much wider circle than those immediately interested in the area with which it specifically deals. This is particularly marked in the first part of the book, entitled "General Considerations." Here Mr. Earle has given us the benefit of his experience in various lands, and in dealing, for instance, with such subjects as irrigation he brings out well the principles underlying practice in countries possessing very different conditions, explains how irrigation may be of value in humid as well as in dry countries, and gives useful descriptions of the methods in vogue in various districts. Other sections in this part which should be of wide interest are those relating to the improvement of the soil, marketing products, farm policy and management, and plant diseases. The division of plant diseases into three general groups—environmental, functional, and diseases due to parasites—and the clear discussion of the methods of dealing with each group will serve to illustrate the successful attempt to make the work more than a mere compilation of facts.

The second part, "The Chief Southern Agricultural Crops," is somewhat unequal in its treatment, but this is apparently in the main intentional, and is correlated with the relative local importance of the plants. Sugar-cane, the cereals, pasture and forage crops, tobacco, cotton, and, in particular, the fruits, are dealt with at considerable length, an account being given, not only of their botanical identity and mode of cultivation, but also of their principal pests, both insect and fungoid. Coffee and cacao are less fully treated, the large group of vegetables are disposed of in a few pages under the name of "Truck Crops," and a few notes on forestry and domestic animals conclude the volume.

The book contains the best account available, within small compass, of the agriculture of the warmer regions of North America and the West Indies, and, as already indicated, has in addition many features which will ensure it being of use also in other parts of the world.

W. G. FREEMAN.

ANALYTICAL CHEMISTRY.

Qualitative Analyse vom Standpunkte der Ionenlehre. By Dr. Wilhelm Böttger. Second, revised and greatly enlarged edition. Pp. xvi+524. (Leipzig: Wilhelm Engelmann, 1908.) Price 10 marks.

IN the second edition of this book, which made its first appearance in 1902, the author has made very considerable additions, resulting in an approximate doubling of the original size. As the title indicates, it is written from the point of view of the theory of electrolytic dissociation. This fact, in itself, may be sufficient to condemn the book in the opinion of the chemists of the anti-ionic school, but there can be no doubt that the basis furnished by the ionic theory is the one which at present must be recognised as meeting with the approval of the great majority of scientific chemists.

The arrangement of the subject-matter is such that

the chapters dealing with general questions and those treating of special matters are separated from one another. There are five sections, of which the first deals with the fundamental conceptions and relationships which are of importance in connection with the scientific study of analytical chemistry. Simple experiments to illustrate the difference between strong, weak, and non-electrolytes, the influence of mass in chemical change, the changes in the properties of acids and bases on the addition of their salts, the formation of complex ions, the difference between double salts and complex salts, are described among others. In the opinion of the reviewer, these preliminary exercises form the very best foundation of any attempt to build up a system of instruction in analytical chemistry which is to have an educational value and provide a mental stimulus for the student.

In the second section the usual instructions for the carrying out of the many operations incidental to analytical work are given. The third is devoted to characteristic reactions of cations and anions, which are arranged in the usual groups, and in the fourth section the processes of qualitative analytical separation are dealt with. In the fifth, the reactions serving for the recognition of the rarer elements are grouped together, and a detachable booklet contains tables for laboratory use.

The text throughout affords evidence of the author's familiarity with the recent literature bearing upon the constitution of aqueous solutions, a knowledge of which is of essential importance for the proper interpretation of the reactions which serve as the basis of analytical work.

The systematic presentation of the subject in terms of the ionic theory and the use of ionic equations may possibly present certain difficulties to the student, but the fact that greater demands are made upon the mental capacity is not without its compensations. At the same time, experience has shown that many reputed difficulties are more imaginary than real, and if, as is undoubtedly desirable, the study of analytical chemistry in the universities and polytechnics is not commenced until the second year of the student's course, Böttger's work will no doubt be adopted by many teachers who desire to eliminate from their courses the unsatisfactory features characteristic of many types of so-called guides to qualitative analysis.

In the interests of English students, it is hoped that the appearance of an English translation of the second edition of the book will not be long delayed.

H. M. D.

OUR BOOK SHELF.

The A.D. Infinitum Calendar. (Liverpool: Collin and Irene.)

WE presume that the title of the above is intended for a sort of pun, and that the A.D. may be written as in the heading with dots, or as below when we are told that it is available for any year from A.D. 1 *ad infinitum*, where the *ad* is taken as a Latin preposition.

We have had many perpetual calendars brought before us, but this is perhaps the most ingeniously contrived for giving by inspection and the adding together of four small numbers (none exceeding six, so that it is easily done in the head) the day of the week corresponding to any day of the year. As a specimen we may take the day on which we are writing, *i.e.* November 18, 1908. For the tens of centuries (19) we take out the number 5; for the number in the century (08,* marked with an asterisk because it is a leap-year) we have 3; for the month November 6; and for the 18th day of it 4. Then by adding 5+3+6+4 we obtain 18, which gives Wednesday in the last column for the day of the week. In the second column (for months called A) January and February are inserted twice, for common years or leap-years, the latter being marked with an asterisk.

As the calendar stands, it will serve until the year 3099, which will do for a *few* generations; but the authors naïvely add that it can easily be extended to go on to the end of time. A caution is perhaps necessary owing to its being so often forgotten that the alteration of the style (on the Continent in 1582 and in England in 1752) effected a two-fold change. The mere altering the rule for observance of leap-year only necessitated a slight shift, easily allowed for in a table. But the dropping of ten days from the Julian to the Gregorian reckoning, which became eleven in the eighteenth century and is now thirteen, was a different matter. Neither the calendar before us nor any similar one can give the days of the week correctly by the Julian reckoning of the days of the month after the change of style, the days of the week agreeing, but those of the month disagreeing by a number which is not a multiple of 7. W. T. L.

The Extra Pharmacopoeia of Martindale and Westcott. Revised by Dr. W. Harrison Martindale and W. Wynn Westcott. Thirteenth edition. Pp. xl+1164. (London: H. K. Lewis, 1908.) Price 10*s.* 6*d.* net.

THIS new edition of Martindale and Westcott's "Extra Pharmacopœia" contains an enormous amount of matter in a small compass, and although 1164 pages in length, 124 pages more than the last edition, by the use of thin paper it remains a volume that can easily be carried in the pocket. In addition to the preparation of our own and of many foreign pharmacopœias, a large number of other drugs and proprietary substances are included, together with tables of atomic weights, weights and measures, tests and solubilities. Of the supplementary matter, arsenical contamination receives special attention, the section on radiography has been brought up to date, "nutrimenta" are considered in a special chapter, in which the work of Fischer on the structure of the protein molecule and the new nomenclature of protein substances receive notice; and serum and vaccine therapy is fully discussed. The elements of bacteriology, opsonins, and the determination of the opsonic index, references to cerebro-spinal meningitis, trypanosomiasis, the *Treponema pallidum* of syphilis, the transmission of Mediterranean fever by goats' milk, the use of tuberculins, Calmette's ophthalmic reaction in tuberculosis, and organotherapy all are considered.

Chapters on mineral waters, analytical memoranda, including electrical conductivity, and a therapeutic index are included. Glossaries of words and phrases likely to occur as directions in foreign prescriptions are given in several languages, and should prove very useful. The index is very full and complete, and the composition of a number of patent medicines is given. The book is emphatically one which no medical practitioner or pharmacist can do without, and it should find a place in the library of every laboratory, for it contains data that may be of service in almost every branch of science. R. T. H.

The British Journal Photographic Almanac, 1909. Edited by George E. Brown. Pp. 1336. (London: Henry Greenwood and Co., 1908.) Price 1s. net.; cloth 1s. 6d.

As each year begins to draw to an end, so this very excellent friend of the photographer makes its appearance. While the style of the volume remains the same, the text, sandwiched in between a mass of advertisements, will be found most useful material for the worker. Among some of the numerous subjects dealt with may be mentioned the epitome of progress since the last issue, while the recent novelties in apparatus are full of interest. The usual tables, both chemical and optical, together with the numerous formulæ for the principal processes, form, as usual, an important part of this publication, not forgetting the calendar, directory of photographic societies, and particulars of the chief photographic associations which are not included in the above directory.

The frontispiece is a coloured portrait of the late Mr. Thomas R. Dallmeyer, from a painting by Sandys, the three colour blocks having been made and printed by Messrs. Hood and Co., Ltd., Middlesbrough.

The great number of advertisements is quite a unique feature of this publication, and the capital indices render them easy to refer to. The volume should naturally find a place in every studio or laboratory where photography is practised.

The American Annual of Photography, 1909. Vol. xxiii. Edited by John A. Tennant. Pp. xliv+328. (New York: Tennant and Ward; London: Dawbarn and Ward, Ltd., 1908.) Price 5s.

THE twenty-third issue of this annual is a volume which will be welcomed by all photographers. It is bristling with a great number of original articles on many subjects, most of which are admirably illustrated. These are for the most part written in a very clear manner, and summarise in a small space the particular speciality of the individual writers. Thus, Mr. A. Radclyffe Dugmore leads off with "Camera Hunting for Big Game," while Mrs. H. C. Sutherland writes about "Animal Photography." "The Photography of Lightning" is dealt with by Mr. Howden Wilkie, with some interesting photographs, and Mr. W. J. Farthing treats of "The Camera in Natural History Research."

In addition to the many articles mentioned above, the volume includes some excellent reproductions of photographs taken by well-known workers.

At the end are gathered together a typical collection of formulæ and tables, the former being selected from the methods of practical photographers. The strong binding and general character of the book reflect great credit on the editor and his co-workers, and the volume should find a home in every photographic studio.

Beiträge zur Naturdenkmalpflege. Heft i. and ii. Edited by Prof. H. Conwentz. (Berlin: Gebrüder Borntraeger, 1907 8.)

It will be remembered that Prof. H. Conwentz, editor of the above publication and Prussian Commissioner for "Naturdenkmalpflege," delivered an address on "The Preservation of Natural Monuments" (NATURE, vol. lxxvi., p. 556) before a joint meeting of Sections K, C, D, and E at the Leicester meeting of the British Association. In this address Prof. Conwentz explained what was meant by "Naturdenkmäler," and also the aims and objects of the Prussian State Department for their preservation. The above periodical is the official organ of the department for Naturdenkmalpflege. The first Heft is subdivided into two main parts. The first part deals with the administration of the department. The second part shows the progress which has been made in the care and preservation of natural monuments.

The main object of the department seems to be directed towards getting the public and private landed proprietors interested in the preservation of all things of natural interest which are in any way threatened with extinction or obliteration. Prof. Conwentz, the head of the department, has travelled over the greater part of the State, and held personal interviews with local authorities, heads of departments of public and other bodies, societies and individuals who are at all likely to be interested in the movement, and, further, a great many lectures have been given all over Germany, and, indeed, in several other countries, in order to stir up public interest in the care and preservation of natural monuments, which is probably the most potent factor of all.

An appendix at the end of the Heft contains much useful information in a very concise form, showing the constitution and function of the State Department for Naturdenkmalpflege. This first number covers the year from April 1, 1906, to March 31, 1907. The demand for copies was so great that a new impression was necessary.

Heft ii. of the Beiträge covers the period from April 1, 1907, to March 31, 1908. It is arranged on the same lines as the previous number, but shows by its size and the amount of new matter it contains that great progress has been made. Many Naturdenkmäler have been catalogued, mapped out, and placed under proper care and supervision. Details of these are given, but care is taken that localities or stations where very rare plants or animals occur are not made public, as it would no doubt defeat the object of the department to let collectors and dealers know of such places. The appendix shows what recent legislation has taken place, and gives other useful information, which appears desirable or necessary for every co-worker.

The Beiträge will appear from time to time, but not at definitely stated intervals, and the size and price may also vary with each new issue.

A. W. B.

Die periphere Innervation; Kurze übersichtliche Darstellung des Ursprungs, Verlaufs und der Ausbreitung der Hirn- und Rückenmarksnerven. By Dr. Emil Villiger. Pp. 110. (Leipzig: W. Engelmann, 1908.) Price 6 marks.

THE manifestations of disease are made so frequently through the nervous system that there can be no doubt of the utility of such a book as this, which seeks to give the clinician a brief and clear description of the anatomy and physiology of nerve paths as a solid basis for diagnostic purposes. It is an elementary book representing well-known facts to serve the purpose of the medical man, its main interest to British neurologists lying in the fact that it represents the modern teaching of German and Swiss medical schools. From a medical point of view the most important part of the nervous system is the sympathetic, by which the viscera are brought into close touch with the central and peripheral nervous system, and by which visceral disease is so frequently reflected, but the sympathetic system is altogether excluded from Dr. Villiger's book. The sensory nerve supply of the body wall, of the pleura and peritoneum is also omitted. The levator palatæ is still described as receiving its nerve supply from the facial nerve. On the other hand, the segmental nerve supply of the muscles of the body and the muscular incoordinations and disturbances which follow lesions of the central nervous system are well described.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

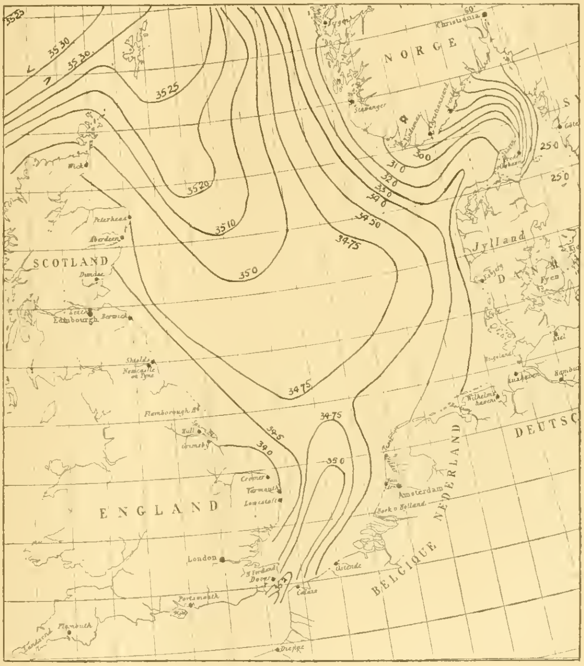
On the Salinity of the North Sea.

THE accompanying chart of the mean salinity of the surface of the North Sea has been constructed from the international observations made during the years 1903–7. A similar chart has been constructed by Mr. Martin Knudsen (dealing with a somewhat shorter period), and our two charts, independently prepared, agree with and confirm one another in a very close way.

The general features of the chart are extremely simple; the highest salinities are found, first, around the Shetlands, and, secondly, in the neighbourhood of the Straits of Dover, and the values are somewhat higher in the former region than they are in the latter, where the connection with the waters of the ocean is more remote. The salinity falls off rapidly in the Skager Rack, and is, on the whole, low everywhere in the immediate neighbourhood of the coast.

We may the more easily comprehend and describe the form and distribution of the isohalines (or curves of equal salinity) by comparing with them the case of the distribution of temperature or of potential in a bar of metal subjected to a flow of heat or of electricity. In such a bar of metal, heated at one end and cooled at the other (as in Forbes's classical experiments), we obtain a series of isotherms running transversely to the "thermal axis," and arranged in an exponential series at increasing distances as we pass towards the cooler end. If, in the next place, we apply new sources of heat along the edges of the bar, it is obvious that the result will be to bend the isotherms from straight into curved lines, concave towards the cooler end of the thermal axis. Lastly, if we substitute for the straight and elongated bar a square plate, and apply our sources of heat and cold at two of its adjacent sides, then the thermal axis will be bent into a curve, and the isotherms will be crowded together upon its concave, and comparatively remote from one another on its convex, side.

Now, neglecting the phenomena in the Straits of Dover, which are of comparatively small magnitude, we have in the accompanying chart a series of isohaline curves which correspond very closely indeed with the isothermal system just described. Our axis is traceable through the Cattegat and Skager Rack, along a bent course in the middle of the North Sea, to its termination in the Atlantic eastward of Shetland; the isohalines, which are essentially transverse to this axis, are everywhere rendered convex towards the ocean by reason of the influx of fresh water from the shore, and these isohalines, while they are comparatively widely interspaced in the southern part of the North Sea and off the east coast of Great Britain, are crowded together off the coast of Norway, that is to say, on the concave side of the axis. Furthermore, we notice that the whole system of curved isohalines is thrust over much nearer to Shetland than to Norway, firstly, I presume, because it is in the neighbourhood of Shetland that the oblique north-easterly track of the so-called Gulf Stream, with its highly saline water, lies nearest to the North Sea, and, secondly, because the inflow of fresh water from the Norwegian coast predominates greatly over that from the coast of Britain. We may follow the parallel a little further, by noticing that, just as our axis is bent within the North Sea, so it is also bent, but in the opposite direction, as it passes from the Cattegat into the Skager Rack. Accordingly, we find in this latter region a disposition of the isohalines comparable, though on a smaller scale, to that within the North Sea itself, for they are crowded together on the concave side of the bent axis, that is to say, towards the Danish coast, and comparatively widely spaced on the Norwegian; while at the same time the whole system is thrust over towards the Danish side by the greater inflow from the Swedish and Norwegian coasts, to which disposition, no doubt, in this case, the course and direction of the outflowing current from the Baltic contribute.



Mean Surface Salinity of the North Sea, 1903–7.

A chart of the mean annual variation of salinity, which variation we can show to be, on the whole, regularly periodic, is found to correspond very closely in its contours with the chart of mean salinity, for the regions of highest salinity are subject to the least variation, and those of the lowest mean salinity to the greatest. At the mouth of the Cattegat, where the mean salinity is about 25 °/₀₀ (or 25 grams of chlorides in a thousand parts of water), the mean annual variation is nearly 10 °/₀₀; at the mouth of the Skager Rack, where the mean salinity is about 31 °/₀₀, the mean variation is about 5 °/₀₀; in the middle of the North Sea, with a mean salinity of 34·75 °/₀₀, the mean variation is only about 0·2 °/₀₀; and in the region of our highest salinities off Shetland, of about 35·25 °/₀₀, the mean variation is less, and probably very considerably less, than 0·1 °/₀₀. A further discussion of this subject, including an account of the distribution of salinities at various depths, and of the phases and other phenomena

connected with the periodic variation, will presently appear in the Scottish Reports of the North Sea Investigation Committee. D'ARCY W. THOMPSON.

University College, Dundee, December 9.

Reform of Zoological Nomenclature.

THE labours of the committee proposed by Mr. Boulenger at the British Association for remedying the abuses of zoological nomenclature will be enormous, even if restricted to the settlement of common generic names. To hope that they should extend to large numbers of species, or to species of the less prominent groups, is, I fear, impossible unless a more wholesale method of dealing with the names be adopted.

The necessity for extending the settlement to a large number of species of such groups as the Polychæta is very pressing, since hundreds of names were given by the earlier workers, whose limited knowledge of the group made their giving a moderately adequate description of the species named an impossibility or apparent superfluity. Without some such arrangement as that proposed below the nomenclature of this and other similarly placed groups will remain in a state of flux for years beyond our generation, and in consequence the labours of the conscientious worker will be not so much to the advancement of knowledge as to the weighing of all sorts of circumstantial and fragments of documentary evidence to determine what some culpably incomplete description really refers to. As a case in point see the list of synonyms for *Aphrodite aculeata* in McIntosh's "Monograph of the British Annelids," and consider the patient and learned labour spent on that compilation which might have been employed in direct scientific investigation. Then compare a case where the species dealt with is not a rather isolated and very well-marked form, but one having several related species living in its vicinity, none of which have any very striking characteristic! The labour in such a case is endless, the conclusion arrived at being always liable to be upset by some purely circumstantial evidence accidentally coming to light.

So far as I can see, the only way in which species names can be dealt with wholesale, and several thousand names be given priority, once and for all, is for the committee to confine themselves to the consideration of books rather than to individual names. I should suggest that experts in the systematic literature of each group prepare short lists of the most important descriptive works. Care would be taken to include only such works as contain a good number of definitions of genera and descriptions of species, and that the descriptions should be adequate and well illustrated. The number of works in each group would not be large, but the number of species contained would be much greater than could possibly be dealt with by any committee attempting to determine the extent of usage of each name separately. The names given to species *described*, whether as new or not in this selection of works, would be made unalterable. In case of synonymy within the list, the rule of priority would apply.

To give an example, again, from the Polychæta. I should suggest the following works to be among those the nomenclature of which should be inviolable:—

(1) Claparède, "Annelides Polychètes du Golfe de Naples" (but possibly not his other work on Polychæta from near the Spanish frontier).

(2) Ehlers, "Die Borstenwurmer," and several recent works on South American collections.

(3) McIntosh, "*Challenger* Reports," vol. xii. The *Challenger* reports would all be reckoned authoritative, I suppose, thus securing an immense number of settled names at once.

(4) McIntosh, "Monograph of the British Annelids."

Some famous works, *e.g.* Kinberg's and Grube's, even the latter's "Annulata Semperiana" I personally should not include, and some voluminous recent literature certainly should be omitted. I do not mean that such works should be allowed to lose any of the usefulness they have at present, but should be searched rather for their facts than their namings.

My plan will certainly cause some unjust neglect of some few well-made descriptions of species, but can any beneficent and effective legislation, on any subject whatever, be framed to avoid all injustice to small minorities? In comparison with the injustice which gives any easy-going name-giver authority to mar the work of the laborious describer, this is nothing.

It has the advantage of substituting the authority of series of the best works for that of the committee. Cavillers may object to the most authoritative committee of living and possibly interested men, but are less able to object to this reinforcement of the authority of the most eminent workers in each group, many of whom are now beyond all personal interest in the preservation or neglect of their particular systems of nomenclature.

My plan is doubtless full of difficulties, but I believe not more so than any other proposed, while the remedy goes deeper, not, as in other cases, merely touching the surface of this great hindrance to progress and order.

CYRIL CROSSLAND.

Port Sudan, Red Sea, November 13.

Mercury Bubbles and the Formation of Oxide Films by Water containing Oxygen in Solution.

THE formation of mercury air bubbles described by Mr. Wright, Sir William Crookes, Mr. Hare, and Prof. Dixon seems to be a different phenomenon from that described by the late Prof. P. G. Tait in his "Properties of Matter" (1899, p. 257) in the following passage:—

"Even so dense a liquid as mercury can be formed into a bubble. We have merely to shake a glass bottle *filled* with water and clean mercury. The bubbles which form on the mercury (often detached) are full of water. Sometimes we see others coming up from the interior of the mercury. These are water-skins full of mercury."

I have repeated Tait's experiment, using a 250 c.c. bottle containing about 50 c.c. of mercury and filled quite full of water. A short, vigorous shaking fills the bottle with a foam of mercury bubbles, which quickly subsides, leaving some isolated bubbles, which also quickly sink to the bottom and disappear in the mass of mercury. The bubbles formed in this way are therefore mercury *water* bubbles, not mercury *air* bubbles. The addition of sulphuric acid to the water stops the formation of bubbles; the shaking then breaks up the mercury into minute solid globules.

During the experiment an observation was made which, while it does not bear directly on the formation of mercury bubbles, is perhaps of some interest. It was found, when water which had not been freed from dissolved gases was used, that the liquid set free by the bursting of the bubbles had a smoke-brown colour by transmitted light. As the foam subsides into the mercury below, this brown cloud is left floating over the surface of the mercury. The cloud left by the bursting of single bubbles can sometimes be observed floating in the upper part of the liquid. With water that has been freed from dissolved gases by boiling this appearance does not occur.

The browned water, after standing for a few minutes, was decanted into a clean vessel, and was watched for about an hour. During this time no deposit settled from the liquid. A drop of the liquid was then examined under the microscope with illumination by an intense oblique beam of reflected light, and also by transmitted light with a high-power objective. Two kinds of particles were present, minute globules of mercury measuring from 2000 to 6000 $\mu\mu$, and shreds and spicules of oxide film. The latter, which are only visible under the oblique beam, are in constant pedetic movement. They are not spherical aggregates, but minute plates, which appear and disappear as they turn and twist in the unidirectional beam of light. The oxide film which forms on the stretched mercury surfaces has, no doubt, the same microstructure as I have found alike in solid and in liquid films—a kind of lenticular granulation due to surface tension. The sudden collapse of the mercury film sheds the oxide film, and causes it to break up into minute lens-like plates or spicules, which are in pedetic movement. In some cases these plates form aggregates of considerable size round the minute mercury globules. These aggregates are sufficiently massive to be visible by transmitted light. G. T. BEILBY.

Glasgow, December 12.

THE STUDY OF STELLAR EVOLUTION.[1]

WE are becoming so accustomed to fresh proofs of Prof. Hale's versatility and thoroughness that the appearance of this volume hardly strikes us as being so remarkable as it would have done had another written it, but even this fact cannot detract from the feelings of wonder and admiration which are forced upon us as we peruse the contents.

It should be noted that this work is not *a* study, but is an account of *the* study, of stellar evolution, telling us of the methods and apparatus applied in attacking the various problems, and how far such means have already been successful. It was at first intended as a handbook to the Yerkes Observatory, but the removal of the author to the new solar observatory at Mount Wilson, with its new equipment and newer methods, rendered it advisable that the scope of the work should be widened.

Prof. Hale looks upon the evolution of stellar systems, not as an entity, but as a part of the general scheme of evolution which began with the Beginning and at present ends in the social systems which govern man, and it is in this philosophical spirit that he introduces his subject in the first chapter. The great differences between the old and the new astronomy are then pointed out, with reference to the changes introduced by the application of photography to the study of astronomy, and the consequent importance of the methods of reduction which have to be applied to the photographic results.

The sun is then discussed as a typical star, and Prof. Hale answers a question which is continually being asked by persons who are not thoroughly familiar with solar work. Why at a solar observatory, such as Mount Wilson, are time and opportunities spent in studying stars and other masses outside the solar system? Why pay attention to those far-away systems which can never, within comprehensible time, exert any influence on terrestrial conditions? The author expunges all doubt in his reply to these questions. Just as the biologist, by studying the lower forms of life, discovers the laws which regulate the life and being of man, so must the solar physicist appeal to those other stars, of earlier and later birth, in order to comprehend solar phenomena.

Those who heard Prof. Hale's evening lecture at the Royal Astronomical Society in 1905 will recognise the sentiment of the succeeding chapters, in which, while describing various instruments, he insists upon the useful work that may be accomplished with very modest equipments, and shows that, if the worker only gives earnest consideration to the choice of a definite research, he may find that his smaller instruments will prove equally efficient with the larger ones. Among the beautiful full-page illustrations at the end of the volume there are a number illustrating this point.

Chapters dealing with the reflecting telescope and the principles of spectrum analysis, in which the work of Herschel, Fraunhofer, Kirchhoff, Huggins, Secchi, Lockyer, Janssen, and others is briefly described, bring the history of these subjects up to date, and lead to a description of grating spectroscopes, their history and manufacture. In this regard it is gratifying to be assured that Michelson has completed a ruling-machine, with an almost perfect screw, designed to rule 14-inch gratings, and has already completed gratings of ten and twelve inches. By constructing a machine with four screws he further hopes to reduce the ruling errors to one-fourth the amount produced in a single-screw machine.

After discussing the phenomena of the sun's surface and surroundings, and the historical discoveries concerning them, the author proceeds to a description of the evolution of the photo-spectroheliograph, in which he has played so great a part. He also emphasises the point that the explanation of the results offered in this chapter is merely an hypothesis which future researches may modify, and refers to the anomalous-dispersion explanation of Julius as one of the possible alternatives.

The perusal of chapter xii. leaves us with the ardent desire that British authorities and capitalists would see eye-to-eye with their American confrères as to the fundamental necessity of fostering scientific work, for Prof. Hale here describes the foundation, equipment and work of the Yerkes Observatory. Here, as in other parts of the book, the author strongly insists upon the necessity for an equipment capable of undertaking the concurrent study of the correlated solar, stellar, and terrestrial phenomena.

Notwithstanding the dictum of Newton and the experiments of Piazzi Smith and others, the question of the advantage of high altitudes for solar work has only become acute during the last decade or so, and no one is much better qualified than Prof. Hale to discuss this question. It is therefore with interest that we read the chapter dealing with this subject, in which he shows conclusively that altitude alone is not necessarily advantageous. Many of the higher peaks surrounding Mount Wilson have been proved to be unsuitable for solar work, whilst the author's experiences of Mount Etna, in July, 1894, were not of the kind calculated to make him regard it as an ideal site from which to attempt the photography of the corona without waiting for a total eclipse. Mount Hamilton, notwithstanding its glorious night "seeing," is said to be unsuitable for solar work on account of the atmospheric movements, adverse to good solar definition, set up by the intensely heated, bare rock which forms the slopes immediately surrounding the summit.

In chapter xiv. Prof. Hale describes the Mount Wilson site, and, from his experience there, defines five specific requirements for a site to be suitable for the prosecution of solar research and its necessary adjunct, the study of stellar evolution. After describing the Snow telescope and discussing the uses of spectroheliograph plates, the author proceeds to the study of sun-spots, and in this chapter we find one of the strongest arguments possible for the inclusion in a solar physics observatory equipment of the apparatus necessary for the correlated study of terrestrial spectroscopy and similar work. Prof. Hale has just previously described the numerous pieces of apparatus fitted up, ready for instant use, in the spectroscopic laboratory, and, speaking of the powerful magnet used to produce the Zeeman effect, he says:—"It is not a question here of detecting magnetic phenomena in the sun, since most careful study has not revealed any evidence of solar magnetic fields capable of affecting the appearance of spectral lines." Yet quite recently, since the above statement was penned, he has published results (Nature, August 20, No. 2025, p. 369) which strongly suggest that the Zeeman effect, or something which produces similar phenomena, is *en évidence* in the sun-spot spectrum!

A chapter on stellar temperatures follows, and in describing the apparatus which has been used in the attempts to measure the stellar heat radiation directly, the author gives some interesting data illustrating the extreme delicacy of the apparatus with which Nichols, working at the Yerkes Observatory in 1898 and 1900,

[1] "The Study of Stellar Evolution; an Account of Some Recent Method of Astrophysical Research." By Prof. George Ellery Hale. (The Decennial Publications, second series, vol. x.) Pp. xi+252; with 104 plates. (Chicago The University of Chicago Press; London: Wm. Wesley and Son, 1908.) Price 16*s*. 6*d*. net.

"Populäre Astrophysik." By Dr. J. Scheiner. Pp. vi+718; 30 plates. Leipzig and Berlin: B. G. Teubner, 1908.) Price 12 marks.

was able to detect the heat radiations received from Arcturus and Vega. The former was found to send us heat equivalent to that given by a candle about six miles away, if there were no absorption by the atmosphere, and Vega less than half that amount.

Following a chapter devoted to the nebular hypothesis we find a discourse on stellar development, and some interesting points are made concerning the various stellar classifications in the light of recent research. For example, Lockyer's temperature classification has been criticised on the ground that the observed changes of intensity of stellar lines might be produced by an indeterminate combination of electrical and temperature action. This has been recognised and reiterated by the author of the classification, who accepts the changes, whatever be their cause, as a basis on which a working hypothesis might be erected. But now we find Prof. Hale writing to the effect that the results obtained in the Mount Wilson laboratory imitation of sun-spot phenomena "seem to favour the view that a temperature classification of the stars, on the basis of the relative intensities of lines, is perfectly possible." In these experiments all electrical phenomena were excluded, but the above statement is not made unreservedly, as shown in the subsequent discussion of the meteoritic hypothesis. The work with the new 60-inch reflector at Mount Wilson, it is hoped, will provide a great deal of information respecting the fainter stars which has hitherto not been obtained.

In dealing with the meteoritic and planetesimal hypotheses, Prof. Hale directs special attention to the outstanding uncertainties respecting the transitional stage, nebula to star, and urges the importance of directing special attention to nebulæ by obtaining photographs of their structures and spectra; this research can only prove fruitful if the persistent prosecution of correlated laboratory experiments is carried out concurrently.

Discussing the question of the variation of the heat received from the sun, the author points out how small an amount of definite measurement has yet been undertaken, and urges that other observatories, in other regions of the earth, should cooperate in the bolographic work.

Kodaikanal, where the dry season corresponds with the wet season in South California, and an Australian station are suggested as localities in which the observations might be profitably inaugurated.

The importance of active cooperation between solar and meteorological observers, such as has of late years been instituted by the International Commission, is also emphasised.

The concluding three chapters (xxiii.-xxv.) are essentially of general interest. In the first the author describes at some length the making of the 60-inch reflector by Ritchey in the Mount Wilson workshops (Pasadena), and illustrations of the process are to be found among the plates. Then some possibilities of new instruments, *e.g.* the 100-inch reflector now under construction, are reviewed, and in the final chapter warm encouragement is given to the amateur observer. This embodies a series of hints on fitting up instruments, and, coming from a master who commenced his far-reaching studies with home-made instruments, they should be especially welcome, as they are essentially practical.

The printing and general get-up of the volume are of the high order one is accustomed to expect from the Chicago University Press, and the 104 full-page reproductions of actual photographs, which are bound up at the end, form by far the finest collection of general astronomical pictures ever yet published in a single volume.

In Prof. Scheiner's book we have a more conventional treatment of the subject of astrophysics, in which, in two parts, the whole subject is discussed under the customary headings and in popular terminology. Thus in the first section of part i. we find simple explanations of the fundamental principles underlying the methods employed, such as those of refraction, reflection, polarisation and dispersion of light, and the capacity and psychophysiological action of the eye considered as the final instrument on which the interpretation of all the phenomena depends to so large an extent.

In the following section the specific instruments are described, and the construction and adjustments of the spectroscope are expounded at length. The determination of absolute wave-lengths introduces us to the principles underlying the employment of the grating, and to the work of Kirchhoff, Doppler, Zeeman, and other pioneers in spectroscopic research.

The discussion of the spectra of elements is interpolated with data, such as the relationships of the spectra to the element's position in the periodic system, which should prove valuable for reference.

Photometry forms the subject of section iv., and the student should find helpful the descriptions and illustrations of the various instruments, and the discussion of the psychophysical actions which have to be accounted for in performing the reductions. The uncertainty which still attaches to the results obtained from attempts to measure the solar heat radiations is discussed in a brief chapter, and is well illustrated by a tabulated statement of the values derived for the solar constant by the various observers from Pouillet in 1837 to the author in 1902; the values range from 1·7 to 3·4 gr. cals., the lowest having been obtained by Vallot in 1896, and the highest by Crova and Hansky in 1897.

The four chapters which bring the first part of the book to a conclusion deal with the application of photography to astronomical work, and so much has already been written about the subject that there is but little new matter for the author to expound; but the instruments are clearly described and their various functions explained, the matter in the text being well illustrated by figures.

In eleven chapters (xviii.–xxviii.), the second part of the book deals with the results obtained from the employment of the instruments and methods previously described. The various solar phenomena, the surface appearance and physical characteristics of the moon and planets, and the results obtained from observations of comets and the zodiacal light are expounded at some length, and are illustrated by drawings and photographs in the text. These figures are generally good, but it is a pity that the drawings of several features, such as the Martian surface and the intensified lines of sun-spot spectra, could not have been supplemented by some of the excellent photographs now obtainable.

Chapter xxiii. deals with the subject of nebulæ, and includes a useful table of nearly eighty N.G.C. nebulæ which have been shown certainly to be gaseous; the equatorial coordinates of these objects for 1900 are given, and a striking feature of the list is the great preponderance of planetary nebulæ. In the description of the physical characters, the distances, motions and extent of these gaseous masses, various tables of data are interpolated, and should facilitate references to the subject. One of exceptional interest is that in which the determined radial-velocities of thirteen nebulæ are shown. Taking mean values, we see that the extremes of approach and recession are −65 and +44 km. per sec., the values obtained for N.G.C. 6543 and 6790 respectively.

The fixed stars and their spectra and variations are next considered, and the various proposals concerning their classification are discussed; but here we cannot but express regret at the lack of scientific spirit which permeates some of the passages. For example, in describing the classifications, presumably to students and general readers, we find the author stating that the classification proposed by Lockyer, having as a fundamental feature the evolution of the heavenly bodies, is, in his opinion, based on such uncertain premises that he neglects entirely any further reference to its foundation and characteristics. Surely a classification which yet remains to be proved inadequate in the explanation of observed phenomena, and which explains so many of the problems of stellar evolution so simply, should not be so summarily dismissed from what is, presumably, intended as a standard work on the subject. How different is Hale's attitude mentioned above. There, whilst making the reservations which he thinks necessary, he discusses the matter in relation to the most recent work, and shows that one, at least, of the fundamental points in the temperature classification is capable of experimental demonstration.

The remainder of the book is devoted to the discussion of radial velocities, novæ, the changes produced in spectra by variation of the conditions under which the light-source is produced, the several types of stars showing extraordinary spectra, and variable stars. In conclusion, there is a chapter (xxviii.) in which the results obtained from celestial photography are discussed, special attention being paid to the photographs of nebulæ and of the Milky Way.

The volume is illustrated by thirty full-page reproductions of photographs and two hundred and ten figures in the text, and should afford German readers a good general view of the study of astrophysics.

WILLIAM E. ROLSTON.

PEKING TO MANDALAY.[1]

THE great development of the facilities for travel in the interior of China that has taken place in recent years is strikingly brought home to us by the narrative of Mr. Johnston, the magistrate of our little port of Weihaiwei, in North China. Since the days of Marco Polo, who himself travelled from the old capital of China to that of Burma, many European travellers, for instance, Baber, Colquhoun, Gill, and Morrison, have passed through much the same localities and mainly by the same route, but none, perhaps, have traversed the greater part of the ground more swiftly than Mr. Johnston. Leaving Peking on January 13, 1906, by the great new inland railway, built by French and Belgian engineers since the Boxer occupation of Peking in 1900–1, he reached Hankow, on the Yangtse, on January 16, a distance of 759 miles, and the journey could have been done in half the time but for the train running only in the daytime, halting overnight and resuming its journey in the morning. From Hankow, shallow-draught steamers owned by British, Chinese, and Japanese companies proceed up the Yangtse thrice weekly to Ichang, at the entrance to the great gorges of the Upper Yangtse, described by Little and others, a thousand miles from the mouth of that river and in the very heart of China. In one of the Japanese steamers our author made this journey in three or four days from Hankow; and ten days more by "red boat" took him 200 miles through the gorges and up the rapids to Wan-hsien, in the rich province of Ssuch'uan beyond the gorges. Here Mr. Johnston proceeded inland to Tachien-lu, visiting by the way the sacred Mount Omei, to the previous descriptions of which by Baber,[1] Little,[2] and others he adds something, though unfortunately he gives no photographs or sketches of the contour of the mountain.

Mount Omei, which the legends associate with the mythical progenitors of the Chinese race, Fu Hsi and Nu Wo, ascribed to the twenty-ninth century B.C., and who have their caves here, early became a centre of the Buddhists. A temple to Buddha is alleged to have been erected here in the reign of Ming Ti (58–75 A.D.), under whom Buddhism is supposed to have been introduced into China. A remarkable feature of this mountain, and one which has evidently contributed to its sacred repute, is the phenomenon of the *anthelia* locally known as the "Glory of Buddha." From the summit of the mountain the awe-struck pilgrim, standing on the edge of a tremendous precipice, which Baber describes as probably the highest in the world, sees, under favourable atmospheric conditions, several thousand feet below him, floating on a bank of cloud, this beautiful iridescent halo in all the brilliant prismatic colours of the rainbow. It is of the same kind as the spectre of the Brocken, and is to be seen under similar conditions in other parts of the Alps and in the Himalayas. The necessary conditions are said on hearsay by our author, who himself was not so fortunate as to see the spectacle, to be a fairly clear sky and a bank of cloud below; but he omits an equally essential condition, namely, that the sun must be on the opposite side of the spectator to the bank of cloud.

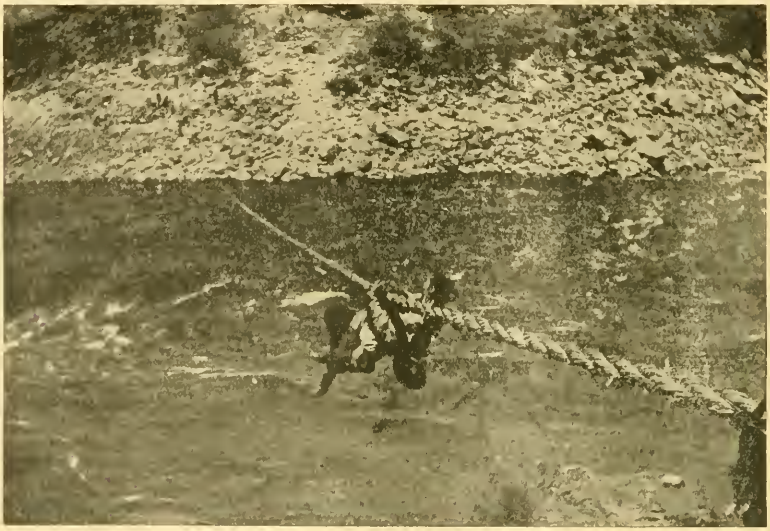
From Mount Omei Mr. Johnston passed to Tachien-lu, the well-known mart and missionary station in western China, and thence down through the wild border country to Burma. The first part of this route lay to the east of the usual track, and led for about a month's march down the valley of the Nya Rong or "Yalung" river to Li-chiang by a road "evidently about the same" as that traversed by M. Bonin in 1895,[3] and by the missionary, Mr. E. Amundsen, in 1898,[4] and crossed by Major H. R. Davies in his exploratory survey of western China. This district and its interesting wild tribes, the Lolo or Man-tzu, and others, are so comparatively unknown that we regret to find so little new about them in this book. The author tells us that his journey "was not undertaken in the special interests of geographical or other science," but to gratify a desire for travel and to acquire some knowledge of the various wild tribes. He gives us, however, little fresh information about the tribes, not even photographs of them that are of any use for ethnological purposes. Indeed, the want of new and more precise observation is the chief defect of the book, and for a travel-book there is far too frequent a tendency to theorise and to inflate the text with discursive and speculative views on the general tenets of Buddhism and on commonplace topics of that religion taken from the well-known works of European writers. So again, when he devotes about ten pages to Mr. Kingsmill's extravagant theory which ascribes to the barbarous Man-tzu tribes of China a descent from "the stock of the Maurya family of north-western India," we think that Mr. Johnston takes too seriously the legends fabricated by Buddhist priests in the countries outside India in order to affiliate themselves to the family of Asoka, the great Buddhist emperor of India. Considerable space, totalling about three pages, is taken up by the introduction of Chinese

[1] "From Peking to Mandalay: A Journey from North China to Burma through Tibetan Ssuch'uan and Yunnan. By R. F. Johnston. Pp. xii+460: with Maps and Illustrations. (London: John Murray, 1908.) Price 15s. net.

[1] "Supplementary Papers," Roy. Geog. Soc., vol. i.
[2] "Mount Omi and Beyond." By A. Little.
[3] *Bulletin de la Soc. de Géog.*, 189[illegible], pp. [illegible] *et seq.*
[4] *Geog. Jour.*, June and November, 1900.

tvne in footnotes for common names which are already transliterated into English in the text. We have seen the Tibetan cryptic spell written in a variety of ways in travellers' narratives, but we do not remember to have seen it rendered "Om mane padme hom," as it repeatedly appears here. On the other hand, Mr. Johnston tells the story of his journeyings pleasantly and effectively, and with much literary skill; and he gives in appendices three pages of valuable vocabularies in the dialects of five tribes (Yung-ning Liso, Yung-ning Moso, Muli [Njong], Pa-u-rong Hsi-fan, and Pa-u-rong Lolo); also some statistical and fiscal information translated at first hand from the official records of Mount Omei and the Ssuch'uan provincial chronicles.

He is a believer in the reality of the "Yellow Peril," and picturesquely supports the tragic conjecture that the Western peoples some day may be crushed out of existence and their yellow successors scarcely regret their disappearance any more than we ourselves regret the extinction of the dinotherium or the ichthyosaurus. "Why indeed should they?" he asks. "When we consider how seldom the memory even of our own dead ancestors touches our sympathies or prompts an affectionate thought, it will not seem strange that in days to come the victorious Yellow man may regard the extinct White man with no more emotion than the visitor to a museum now regards the wire-linked bones of a prehistoric monster. No creature that is doomed to failure in the struggle for existence need look to the conquerors for the least sign of pity or sympathy. No less cheerfully warbles the thrush because the great auk will flap his ineffectual wings no more. Even the crocodile refrains from shedding tears over the fossil remains of the Triassic *stagonolepis*. It behoves us to remember that victory in the struggle for existence is not a victory once and for all. The doom of the conqueror in this fight is that he must never sheath his sword. New challengers are ever pressing into the lists, and the challenged must ever go armed and with lance in rest." L. A. W.



Crossing the Yalung River. From "From Peking to Mandalay."

INTERNATIONAL PHYSICS.

RECENT work at the Bureau international des Poids et Mesures is described in the volumes referred to below.[1] The volumes, like their predecessors, are full of interest to the physicist concerned with exact measurements, and are a monument to the services rendered to science by the International Committee of Weights and Measures and the director and staff of the well-known institution at Sèvres. Though twenty-two nations participate in the work of the committee, the total budget of the institution is limited by statute to 4000*l*. a year. This sum is made up by contributions by the different nations on a scale based on their respective populations, the latter being multiplied in each case by an appropriate factor, 1, 2, or 3, according as the metric system is not employed, is permissive, or is obligatory. The United Kingdom recently passed from Class (1) to Class (2), and, paying only on the population of the mother country, contributed, in 1907, 6339 francs, or about one-sixteenth of the total sum required.

After some interesting correspondence between the International Committee and the British Government on the question of the representation of the colonies belonging to this country, Canada has just entered the convention as an autonomous nation having its own delegate.

At the present time Great Britain is in the happy

[1] "Procès-verbaux des Séances du Comité international des Poids et Mesures." Deuxième Série. Tome iv.
"Travaux et Mémoires du Bureau international des Poids et Mesures." Tome xiii. (Paris: Gauthier-Villars, 1907.)

position of being the only nation having two representatives on the committee. The circumstances leading to this are detailed in the "Procès-verbaux." The two members are Major MacMahon, F.R.S., and Sir David Gill, K.C.B., F.R.S.

One of the most important pieces of work recently completed at the bureau is the new study of the relation between the metre and the wave-length of the red cadmium line. The classic research of Messrs. Michelson and Benoit fifteen years ago laid the foundation of a whole system of independent controls on the invariability of the prototype. Although the maximum divergence of the three independent determinations made was only one micron (0·001 mm.), and the probable error of the mean considerably less, yet it was felt desirable to repeat the work with the highest possible refinements. This has been done by Messrs. Benoit, Perot, and Fabry, employing a totally different type of interference fringes from those used in the earlier work. By this change and by the use of "invar," the laborious "build-up" process of the older method has been greatly shortened, and the precision of the measurements much enhanced. The results may be stated as follows after all corrections have been applied:—

Mean of older determinations,

$$1 \text{ metre} = 1\ 553\ 164 \cdot 03\lambda_R \text{ or } \lambda_R = 0\mu \cdot 643\ 847\ 00$$

New determinations,

$$1 \text{ metre} = 1\ 553\ 164 \cdot 13\lambda_R \text{ or } \lambda_R = 0\mu \cdot 643\ 846\ 96$$

the measurements being made in dry air at 15° C. and under 760 mm. pressure.

Among many other matters of interest in the "Procès-verbaux" is an appreciation of the spectroscopist Thalen, formerly the representative of Sweden on the International Committee, written by his successor, M. Hasselberg. After the application of certain corrections, the author shows that the agreement of Thalen's measurements of the wave-lengths of the three principal cadmium rays with those of Michelson is extraordinarily close. Rowland's values are higher in each case by about one part in fifty thousand.

An appendix deals with the behaviour of nickel steel standards of length. According to the latest investigations, a metre bar of the alloy invar, annealed in the usual way at 40° C. for many hours, *grows* after this treatment, at first somewhat rapidly for work of the highest precision—a micron in 100 days—and afterwards at a diminishing rate. A curve is given showing that a bar which has been under observation for 4000 days has not yet quite ceased to change. During the whole period, however, its change is less than fifteen microns. There is no need to emphasise the enormous utility of invar for many purposes, though this phenomenon would appear to render it less suitable for absolute standards than was once supposed.

Passing now to the volume of the "Travaux et Mémoires," we find the papers included in it are six in number. Three of these relate to work done some time ago by Dr. Chappuis before his departure from Sèvres, the first being an account of further studies on the gas thermometer. This is followed by full descriptions of his now classic researches on the dilatation of water and of mercury. The first paper, of sixty-six pages, deals with a repetition of the well-known experiments which led to the adoption of the hydrogen scale as the recognised international standard of temperature over ordinary ranges. Using both the original large reservoir of platinum-iridium and one of hard glass, values were obtained for the coefficient of expansion of hydrogen under one metre initial pressure and at constant volume, substantially identical with those found earlier. No perceptible difference of "march" was found between the constant-volume and constant-pressure hydrogen scales between 0° and 100°. Many data are also given for nitrogen and carbonic acid.

An elaborate paper by M. Daniel Berthelot discusses the theory of the gas thermometer and the thermodynamic scale. It is proposed to deal with this paper in a later article on thermometry.

Other papers full of great practical interest deal with the general methods of standardisation of divided scales and of boxes of weights. These give, in a summarised form, all the results of the unrivalled experience of Messrs. Benoit and Guillaume and the Sèvres laboratory on these points. The remarks of Dr. Benoit in the early pages of his paper on the standardisation of weights should be studied by every constructor of weights of precision.

NOTES.

Sir James Dewar, F.R.S., has been elected an honorary member of the German Chemical Society.

Dr. F. W. Pavy, F.R.S., consulting physician to Guy's Hospital, has been awarded the Godard prize of 1000 francs by the Paris Academy of Medicine, for his works on carbohydrates and diabetes.

The death is announced, at fifty-one years of age, of Dr. Giuseppe Ciscato, professor of theoretical geodesy in the University of Padua.

A special general meeting of the Geological Society will be held on Wednesday, February 10, 1909, in order to consider the result of the vote of the fellows on the question of the admission of women into the society.

We learn from *Science* that Prof. E. B. Poulton, F.R.S., will give the annual address before the Entomological Society of America at its Baltimore meeting on December 31. The title of the address will be "Mimicry in the Butterflies of North America."

Dr. H. Brereton Baker, F.R.S., Lee's reader in chemistry in the University of Oxford, will deliver the Wilde lecture of the Manchester Literary and Philosophical Society on March 9, the subject being "The Influence of Moisture on the Combination of Gases."

The Broca prize of 1500 francs for 1908 has been awarded by the Anthropological Society of Paris to Dr. Paul Rivet. The prize was founded in 1881 by Madame Paul Broca, and is awarded for the best memoir on human anatomy, comparative anatomy, or physiology in relation to anthropology. The next award will be made in 1910.

A movement, supported by the Linnean Society of New South Wales, is on foot to approach the Australian Government with the object of having Barrow Island, sixty miles off the north-west coast, set apart as a fauna reserve. The island, which is remarkable for its kangaroo, bandicoot, rat, and wren, none of which occurs on the mainland, is likely to be leased for sheep-farming, to the detriment of the fauna. The wise policy of the Crown's retention of islands as sanctuaries for wild life is being amply justified by the experiences of New Zealand and the United States, and the Barrow Island fauna is worth effort to save.

The Academy of Natural Sciences of Philadelphia has appointed Dr. A. E. Brown as its delegate to the University of Cambridge Darwin memorial celebration.

According to *Science*, although Darwin became a member of the Dresden Academy in 1857, before the publication of the "Origin of Species," it is probable that to the Philadelphia Academy belongs the honour of having been the first foreign society to accord his great work official recognition. He was elected a correspondent on March 27, 1860. To his election Darwin refers appreciatively in a letter to Lyell dated May 8 of that year.

MR. ROOSEVELT will be accompanied on his African expedition by Messrs. Edgar A. Mearns, Edmund Heller, and J. Alden Loring. Mr. Mearns is an army surgeon, who has written an account of the "Mammals of the Mexican Boundary of the United States," as well as numerous papers on zoology and botany. He is the founder of the American Ornithologists' Union. Mr. Heller is a zoologist, formerly on the staff of the Field Columbian Museum at Chicago. He has had some experience of African travel, having been a member of Mr. Carl E. Akeley's exploring party in 1905. Mr. Loring is an authority on the smaller mammals, and is well known in America as a collector.

THE Carnegie Institution has made arrangements for what should prove to be important work in the development of magnetic science. According to a Central News message from New York, a vessel is being built under the auspices of the institution every portion of which is to be absolutely non-magnetic, even the anchors being made of bronze. The ship is to be used for the purpose of studying magnetic conditions in all parts of the world. With funds provided from the same source, Dr. Thomson and Prof. Beattie are, a special correspondent of the *Times* reports, engaging in a Cape-to-Cairo trek with the view of extending the magnetic survey through Africa, on which they have been at work for some ten years, sometimes at their own expense and sometimes assisted by colonial Governments.

EVIDENCES of the growing interest in aëronautics among men of science and others of all nationalities continue to be forthcoming. The Aëronautical Society of Great Britain has just acquired an experimental ground near Dagenham Station, which is about half a mile long and the same distance in width. It includes certain mounds about 50 feet high, which will be useful for testing models. It is expected that the ground will be opened at an early date, and that it will be provided, as soon as funds are available, with a completely equipped scientific establishment. The Paris correspondent of the *Globe* reports that a proposal is to be made in the Chamber of Deputies asking the French Government to arrange an international aëronautical exhibition for 1910, and the United States Secretary of War in his annual report just presented to Congress asks for 100,000*l.* for army aëronautics. It will be remembered that last session a grant of 40,000*l.* was sought unsuccessfully by the Congress War Department.

THE committee of the Research Defence Society has circulated a report dealing with the work accomplished by the society since January last, the month in which it was founded. There are now 1650 members, of whom 160 are ladies. Rules for the society have been approved by the committee, and will be submitted in due course to a general meeting. Branches have been formed, or are being formed, at Birmingham, Bournemouth, Cambridge University, Clifton, Dublin, Edinburgh, Leeds, Liverpool, Manchester, Oxford, and Torquay. Eleven pamphlets of an explanatory kind have already been issued by the committee, and about 500 bound sets of these have been sent to public free libraries and to the libraries of certain scientific and educational institutions. Representatives of the society have spoken at several debates, in London and in the provinces, on the subject of experiments on animals. The report points out that the society will be glad to assist any person who wishes to lecture on the results that have been obtained by the help of research in the prevention and treatment of disease.

THE construction of a new tunnel under the Thames at Rotherhithe, for wheeled traffic and foot passengers, was described in a paper read by Mr. E. H. Tabor before the Institution of Civil Engineers on December 8. The tunnel is 30 feet in diameter, 3 feet more than the Blackwall Tunnel, which it resembles in many ways. It is longer, however, owing to the docks on each side of the river making an oblique crossing necessary. The approaches include about 1000 feet of tunnel, curved to a radius of 800 feet, and special machinery was necessary for facing the cast-iron segments used in the lining of this part. In order to find the nature of the strata as the work progressed, a pilot tunnel was driven in advance of the main one by aid of a shield fitted with a rotary excavator. The work has been carried to a successful issue in four years, or in eighteen months less than was allowed for it, and the actual cost of about one million pounds is somewhat less than the original estimate.

THE *Times* correspondent at Stockholm states that the Nobel prizes awarded for the year by the Swedish academies were distributed on December 10 with the usual ceremonies and commemorative speeches. The award to Prof. Rutherford (chemistry) was made on account of his researches in radio-activity; to Prof. Lippmann (physics), for discoveries in connection with colour-photography; to Prof. Metchnikoff and Paul Ehrlich (medicine), for their researches in the subject of natural and acquired immunity; and to Prof. Rudolph Eucken (literature), for his philosophical works. All the prize-winners, except Prof. Metchnikoff, who was prevented from attending, were present to receive their prizes, consisting of a medal, diploma, and a cheque for 7680*l.*, at the hands of the King. Prof. Metchnikoff's prize was handed, on his behalf, to the Russian Minister, Baron Budberg.

As already announced, the Australasian Association for the Advancement of Science will meet in Brisbane on January 11 next. The association will come of age next year, and the meeting will inaugurate the jubilee year of Queensland, the history of which as a separate State dates from 1859. The new president of the association is Prof. W. H. Bragg, of Adelaide, while the sectional presidents are Prof. Pollock, of Sydney (astronomy, mathematics, and physics); Prof. Easterfield, of Wellington, N.Z. (chemistry); Prof. Skeats, of Melbourne (geology and mineralogy); Mr. Charles Hedley, of Sydney (biology); Mr. A. H. S. Lucas, of Sydney (geography); Mr. A. G. Hamilton, of Wellington, N.Z. (ethnology and anthropology); Mr. G. H. Knibbs, of Melbourne (social and statistical science); Mr. H. W. Potts, of the Hawkesbury College (agriculture); Prof. R. W. Chapman, of Adelaide (engineering and architecture); Dr. J. Mason, of Wellington, N.Z. (sanitary science and hygiene); Mr. Peter Board, of Sydney (mental science and education). The acting permanent secretary, Mr. J. H. Maiden, can be addressed at the office of the association, Royal Society's House, Sydney, and will be glad to give further particulars and to enrol members for New South Wales.

THE new radio-telegraph station, which has been erected for the Post Office at Bolt Head, South Devon, as stated in NATURE of December 10 (p. 166), was opened by Mr.

Sydney Buxton, the Postmaster-General, on December 11. The station will be available for communication with all ships fitted with wireless telegraphy, whatever their nationality and whatever the particular system of radio-telegraphy with which they may be equipped. It will be worked in accordance with the provisions of the International Radio-telegraphic Convention, which was ratified by his Majesty's Government in June last, and came into operation on July 1. The great majority of the liners which call at ports in the English Channel can be communicated with through the station. It will also be available for transmitting, to and from ships, messages originating at or destined for places abroad. The range of the station is 250 miles, but for the most part the station will probably not have occasion to exchange messages with ships beyond 100 miles. The station will also be used for communication with the Channel Islands if there is any interruption in the telegraph cable between England and the islands. In the course of an address at the opening of the station, Mr. Buxton pointed out that the primary use of wireless telegraphy is for communication from ship to shore and from shore to ship. He added that the cost of wireless stations for shore-to-shore communication is far less than that of a cable, and, further, that in mountainous or inaccessible districts, where the erection or maintenance of land lines is impracticable or exceedingly costly, connection by wireless telegraphy may be the most effective means of communication.

Dr. Charles Edward Beevor, whose death on December 5, at the early age of fifty-four, we announced with sincere regret last week, was for five-and-twenty years an ardent worker in the rapidly extending field of neurology. His interest was early centred on the action of muscles, and his Croonian lectures, delivered in 1907, contained the fruits of patient observations extending over many years. Recently, he published in the Philosophical Transactions of the Royal Society an extensive monograph on the distribution of the arteries of the brain, illustrated with colour-photographs from his beautiful preparations. This research was the result of enormous industry, for in many instances five cerebral arteries were injected simultaneously with coloured fluids. His Lettsomian lectures, dealing with the diagnosis and localisation of intra-cranial tumours, were the fruit of much careful observation. Owing to his extreme modesty and the unpretentious way in which he worked, the value of his observations was, until recently, known mainly to members of the neurological section of the Royal Society of Medicine, of which he was president at the time of his death; but, within the last few years, neurologists all over the world have recognised the merits of his work, and this summer, by special request, he delivered an address to the American Medical Association. Generous and unassuming to a remarkable degree, he thought little of his own researches compared with those of his colleagues. During the preparation of the Croonian lectures it was difficult to make him understand that what he called "simple facts" were unknown outside the circle of his neurological friends. He belonged to that rare group of men who inspire, not only respect, but affection in all who are brought into contact with them.

Dr. Otis Tufts Mason, head curator of the division of ethnology of the United States National Museum at Washington, passed away on November 5 at the age of seventy years. Dr. Mason was the great exponent of the technology of the American Indians; the general trend of his studies was embodied in two valuable little books, "The Origins of Invention" (London: Walter Scott, 1895), and "Woman's Share in Primitive Culture" (Macmillan, 1895). Most of his memoirs were published in the Annual Reports of the United States National Museum. The following imperfect list will give some idea of his activity and wide range of interests:—"The Human Beast of Burden" (1887), "Cradles of the American Aborigines" (1887), "The Ulu or Woman's Knife of the Eskimo" (1890), "Influence of Environment upon Human Industries or Arts" (1896), "Pointed Bark Canoes of the Kutenai and Ainu" (1899), "Traps of the American Indians" (1901), "A Primitive Frame for Weaving Narrow Fabrics" (1901), "Aboriginal American Harpoons" (1902). Dr. Mason was a great authority on American basketry, and published several papers on the subject; and in 1904 appeared his memorable work, "Aboriginal American Basketry: Studies in a Textile Art without Machinery," which consists of 377 pages, 212 figures in the text, and 248 plates, which will long remain the standard work on the subject. Dr. Mason arranged some very instructive cases in the museum illustrating the evolution and distribution of various implements, and no one who has had the privilege of being taken round the U.S. National Museum, and especially the grand collection of baskets, by Otis T. Mason will ever forget the erudition and enthusiasm of that lovable man.

The annual general meeting of the Royal Agricultural Society was held on December 9. The report of the council announces that in recognition of the valuable services rendered by him to the agriculture of Canada, the council has elected, as an honorary member of the society, Dr. William Saunders, C.M.G., Director of Experimental Farms, Department of Agriculture, Ottawa. The Earl of Jersey has been nominated for election as president of the society for the year 1909. The seventieth annual show of the society will be held at Gloucester on June 22–26 of next year, and the show in 1910 will be held at Liverpool. At the Woburn Experimental Station field trials have been begun with the growing of different varieties of lucerne, and on the use of calcium cyanamide on corn and root crops; also, the influence of inoculating methods for lucerne and white clover has been tried. Further work has been done at the pot-culture station on the action of magnesia in soils, and, for the Royal Commission on Sewage Disposal, an additional year's work on the utilisation of sewage sludges has been conducted. In the botanical department of the society a bacterial disease of swede turnip was investigated, which had rendered an entire crop a failure. Black-scab disease of potato, more correctly known as potato canker, made its appearance again in many places. This pest, by its steady increase, threatens to be as serious for potato growers as the potato disease. Various injuries affecting roses, potatoes, beans, peas, turnips, and swedes were reported upon. The zoological department reports that, on the whole, crops appear to have been freer than usual from insect attack during the past year. Much attention has been given to a disease of the pea plant, which, although apparently widespread, has hitherto escaped observation in this country. It is due to the so-called corn thrips, *Thrips cerealium*. The general interest in the external parasites of domestic animals, which has been excited by the discovery of their power to communicate disease, is still on the increase, and numerous ticks and other animals are continually sent to the society for identification from various parts of the world.

A lecture on the Danish North-east Greenland Expedition was delivered at a meeting of the Royal Geographical

Society on December 7 by Lieut. A. Trollé, R.D.N. The principal object of the expedition, which was planned by the late L. Mylius Erichsen, was to explore the north-east coast of Greenland from 77° N. lat. to the cairns erected by Peary in 82° N. lat., and the east side of Peary Land in about 83° N. lat. The vessel *Danemark*, a steam barque of 242 tons register, carried a fully equipped expedition, with supplies for three years, and reached Koldeway Island (76° 20′ N. lat., 18° 30′ W. long.) on August 13, 1906, after thirteen days' navigation through 125 miles of drift ice. Winter quarters were ultimately established near Cape Bismarck (76° 46′ N. lat., 18° 37′ W. long.), where meteorological, magnetic, and tidal observations were established, and a number of expeditions went northwards for the purposes of mapping and placing depôts containing stores for subsequent journeys. Towards the end of March, 1907, expeditions set out northwards in four divisions. The fourth and third divisions returned in May with valuable cartographical material; the second returned on June 23, after a remarkable journey of some 1250 miles, having reached Cape Bridgman (83° 30′ N. lat.). The first division, under Erichsen, did not return, and it was only after several fruitless attempts at rescue that a sledge party sent out in the following March definitely ascertained that all the members of this division had perished. The precise value of the scientific results of the expedition is not yet known, but it is certainly exceptionally high. Large collections of ethnographical, geological, zoological, and botanical specimens have been secured, a large area of newly discovered land has been accurately mapped, and a valuable series of meteorological observations, including kite observations of the upper atmosphere, has been recorded.

"THERE is no doubt that the hopes expressed by Prof. Koch and others that atoxyl would prove a general and permanent cure for cases of sleeping sickness must now be abandoned. . . . We have at present no other treatment, apart from atoxyl and its allies, which has shown any signs of successful results whatever." These two not very hopeful statements are the opening and closing sentences in the introduction written by Dr. A. D. P. Hodges to the Quarterly Report on the Progress of Segregation Camps and Medical Treatment of Sleeping Sickness in Uganda, by Captain A. C. H. Gray, published by the Sleeping Sickness Bureau. Captain Gray's report contains a full account of the results obtained by various methods of treatment in the three sleeping-sickness camps in Uganda, and if the outcome is not so encouraging as might be wished, the publication of so much experiment and experience in the treatment of sleeping sickness will be of great value to those engaged in the difficult quest of a remedy for this terrible scourge.

WE have to acknowledge the receipt of vol. ii., No. 70, of the *Anatomical Record*, a serial published at Philadelphia, and largely devoted to reviews of anatomical literature.

THE latest issues of the Proceedings of the U.S. National Museum include the following, viz.:—a revision of certain species of Noctuidæ hitherto included in Homoptera, by Mr. J. B. Smith (No. 1645); new American Palæozoic Ostracoda, by Messrs. Ulrich and Bassler (No. 1646); and descriptions of fossil crabs from California, by Miss Rathbun (No. 1647).

WE are indebted to Mr. A. J. Jukes-Browne for a copy of a paper on the bivalve molluscs of the "Venus" group from the older Tertiary formations of England and France, this paper being extracted from the October issue of the Proceedings of the Malacological Society. In addition to re-defining the genera, the author makes numerous emendations on the nomenclature commonly in use among palæontologists in this country.

THE Horniman Museum and Library at Forest Hill, according to the sixth annual report, continues to make steady progress, both as regards the increase of the collections and in the matter of attracting visitors. The increase during the past year is specially notable in the ethnological department, the additions including implements and other specimens from the French caves, presented by the Christy trustees, and palæolithic implements from Swanscombe, Kent, the gift of Mr. J. Cross.

SPECIAL attention may be directed to a paper by Mr. R. L. Moodie in the October issue (vol. xix., No. 2) of the *Journal of Morphology* on the lateral-line system in extinct amphibians. Out of the five groups into which the stegocephalian amphibians are divided, a lateral-line system is found in all except the Aistopoda. As a rule, the system presents itself in the form of the channels of grooves constituting the "lyra" on the skulls of the typical labyrinthodonts; the smoothness of the bottom of these canals, which is most developed in the Stereospondyli, being apparently a feature distinctive either of age in the individual or of specialisation in the group. While these canals differ to some extent from the slime-canals of certain fishes, such as Amia, yet some degree of homology between the two types of structure can be traced. For these canals on the stegocephalian skull, the author proposes definite names. In the branchiosaurian group the head-canals are lacking, and their place is taken by a true "lateral line" on each side of the tail, similar to that of the modern salamander Necturus. An important corollary to, or rather result of, the investigation is the determination that the bone originally termed the squamosal in the stegocephalian skull is really that element, and not, as it has been attempted to prove, the supratemporal. The paper closes with the determination of the homology of other elements in the stegocephalian skull with the cranial bones of fishes.

WE have received from the author, Dr. W. L. H. Duckworth, an admirable descriptive catalogue of the specimens illustrating the comparative osteology of man and the higher apes contained in the museum of human anatomy at Cambridge. Although intended primarily for university students, this fully illustrated pamphlet of forty pages is well worthy of the best attention of naturalists, since it contains several items of information which it would be difficult, if not impossible, to find elsewhere. As an example we may cite the author's account of the distinctive characteristics of the heads of the gorilla and chimpanzee, which runs as follows:—"In the head of the gorilla the chief points of interest to be noted are the prominent brow-ridges, the flatness of the nose, the remarkable elevations on each side of the nasal aperture, the short but prominent upper lip, and the small ears with inconspicuous lobules. The nuchal region is not depressed as in man, for in the gorilla the great development of the muscles of the back of the head fills up the space between the head and the shoulders. . . . The head of the chimpanzee is smaller and rounder, and though the brow-ridges are very prominent and the upper part of the nose is depressed, yet the physiognomy is very different, owing mainly to the smaller size of the nasal alæ, and the long protruding upper lip. The ears, too, are different, being very large. There is also a slight but distinct nuchal depression."

The habits of crinoids form the subject of a suggestive paper by Mr. A. H. Clark in the November number of the *American Naturalist*. From the very nature of the case, very little can be actually known with regard to these deep-sea organisms in the living condition, so that we must depend largely upon inference in trying to ascertain their nature. Their food consists, however, of minute pelagic organisms and small crustaceans, and it is obvious that, as a rule, the largest supply of this nutriment will be obtained by those individuals which live in deep water, as not only will they obtain what they can collect by themselves, but they will also receive a rain of carcases from the upper layers. As a corollary of this, it appears that the size of these organisms depends upon the amount of their food-supply, so that the largest individuals ought to occur in the deepest water. On the other hand, where streams of ice-cold water, as on the west coast of Greenland, or still larger quantities of fresh water at a higher temperature, as on some of the coasts of Cuba, Guadeloupe, and Japan, flow into the ocean, they prove fatal to minute organisms, and in such situations the greatly increased food-supply renders it possible for crinoids to flourish and attain a large size in comparatively shallow water. Indeed, in some instances the individuals of various species attain their maximum size in situations of this nature. Crinoids present all colours except blue, and it appears that the smaller stalked forms are invariably yellow, which, as among parrots, may be the equivalent of no colour at all.

A revised second edition of the guide to Sowerby's models of British fungi on exhibition in the Natural History Museum at South Kensington has recently been issued. The publication, obtainable at a popular price, provides a fairly ready means of identifying the common larger Basidiomycetes and Ascomycetes. The descriptions in the new edition are still confined to the models, but omitted genera are mentioned. The most observable change is the division of species, formerly grouped under Peziza, under the genera Otidia, Sarcoscypha, Macropodia, Plectonia, and Peziza. A serviceable addition has been furnished in the glossary.

A description, with maps, of the vertical distribution of plants in the Balkan States is contributed by Prof. L. Adamović to *Petermann's Mittheilungen* (vol. liv., part ix.). The horizons are broadly demarcated as lowland, upland, montane, alpine, and subnival. The wheat fields rise to an altitude of nearly 4000 feet, and about the same elevation one reaches the limit of fruit trees, also of such trees as the walnut, *Corylus coturna*, and the chestnut. The hornbeam, poplar, and birch continue to the middle of the montane region, where they give place to beech, fir, and Scots pine. At the lower limit of the subalpine region, about 6000 feet, woods are no longer formed, and above this altitude the juniper and mountain pine are reduced to bushes.

Of various plant diseases discussed by Mr. E. S. Salmon in his report on economic mycology for the year 1907–8, issued from Wye Agricultural College, the American gooseberry mildew, *Sphaerotheca mors-uvae*, and "warty" disease or "black scab" of potatoes, caused by *Chrysophlyctis endobiotica*, must be classed as extremely noxious pests, and the apple scab, due to the fungus known as *Fusicladium dendriticum* or *Venturia pomi*, should be recognisable by all fruit-growers. With regard to the first-named, Mr. Salmon continues to urge the necessity for more drastic measures, and very rightly foresees in the potato scab another insidious pest that calls for systematic and compulsory eradication. Apple scab is fortunately less dangerous, being amenable to treatment, but growers will be well advised to digest the advice given regarding Bordeaux mixture for controlling this and other fungal pests.

Dr. H. Molisch describes in the *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften* (Vienna, vol. cxvii., part i.) some experiments upon forcing the resting shoots of woody plants by soaking them in warm water. Twigs of the hazel, bearing male catkins, placed for twelve hours in a bath registering about 30° C. in mid-November, and then removed to a warm house, were hastened into flower in eight days. Flowers of Forsythia similarly treated developed in a fortnight. Lilac, dog-wood, horse-chestnut, and other shrubs or trees were also responsive to treatment. The stimulus is only effectual at a certain period, and appears to be distinctly localised. Staminate buds of hazel could be forced in November, but twigs bearing pistillate flowers could not be stimulated until December. As showing the localised nature of the effect, a photograph of a hazel shoot is given where the branches on one side that had been steeped are fully grown, while the branches on the other side remain quite dormant.

It is well known that the central regions of Australia are too dry for successful cultivation without irrigation. There exists a vast artesian basin, but unfortunately the water obtained from the bores contains sodium carbonate, and is thereby rendered so alkaline that it cannot be used for irrigation purposes. A suggestion has been put forward that nitric acid should be mixed with the irrigation water in sufficient quantity to convert the carbonate into nitrate, *i.e.* to change the injurious constituent into a valuable fertiliser. The practical difficulties to be overcome are very considerable, but a successful result would be of incalculable benefit, and the scheme is being investigated in the chemical laboratory of the Sydney Department of Agriculture.

In the Memoirs of the Indian Meteorological Department (vol. xx., part iv.) Mr. R. L. Jones discusses types of weather in the south of the Madras Presidency. The most important types, corresponding to the four seasons, are:—(1) cold-weather type, late December to February; (2) hot-weather type, March to May; (3) south-west monsoon type, June to early October; (4) north-east monsoon type, October to December. Charts showing the 8h. a.m. pressure distribution for each of these have been selected from the published daily weather reports, and explanatory notes are added to each. Abnormal conditions sometimes occur; the change, however, from one type to another takes place gradually as the year advances. In order to appreciate these, Mr. Jones deals with the normal and the most abnormal weather types for each month. The subject is important, and very interesting; it has been a favourite inquiry in various countries, *e.g.* Abercromby's "Principles of Forecasting," published by the Meteorological Council in 1885, deals with the question in considerable detail, so far as relates to the weather of the British Islands.

When we use force to move a body or impede movement we are conscious of our effort exerted. Reasoning from this human experience, Sir John Herschel suggested in his "Outlines of Astronomy" that the movements of falling bodies, or of any matter in space, are "the direct or indirect result of a *consciousness* and a *will* existing *somewhere*, though beyond our power to trace, which force we term *gravity*." Prof. Karl Pearson refers to this animistic view in his "Grammar of Science," and Dr.

O. Z. Bianco, of the Royal University of Turin, now sends us a quotation from Schopenhauer's dissertation "Ueber den Willen in der Natur" to show that the German metaphysician accepted Herschel's speculation as to the cause of motion of inorganic matter under the influence of gravitation. Dr. Bianco deals with the same subject in a paper entitled "Schopenauer e la gravitazione universale," published in the *Rivista Filosofica* in 1906.

THE *Physical Review* for October contains a paper by Prof. E. F. Nichols and Dr. W. S. Day on new groups of residual rays in the long wave spectrum. The substances tested were rock salt, ammonium chloride, witherite (barium carbonate), and strontianite (strontium carbonate). The radiation from a group of Nernst burners was reflected in succession from five plane surfaces of one of these materials, and, after passing through a spectrometer composed of concave silvered mirrors and a wire diffraction grating, fell on a Nicholls radiometer, the deflection of which could be observed. The residual wave-lengths found are:—for rock salt, 52·3; for ammonium chloride, 51·4; for witherite, 46·0; and for strontianite, $43 \cdot 2 \times 10^{-5}$ centimetre.

A LARGE part of the November number of the *Physikalische Zeitschrift* is devoted to the papers read at the Versammlung deutscher Naturforscher und Aerzte at Cologne in September. Amongst a number of interesting communications, we note one from Dr. J. Classen, of Hamburg, on the value of the quotient electric charge by mass for the kathode rays. His method is that of Kaufmann, in which the velocity of the electron is taken to be that due to its passage through the electric field between kathode and anode, and the effect of a magnetic field on the path of the electron is measured. In Dr. Classen's experiments a Wehnelt kathode is situated a millimetre in front of a large anode with a hole a millimetre diameter at its centre, and the discharge tube is placed in a magnetic field due to two large coils arranged in the Helmholtz manner. The deflections of the rays are determined photographically. The valoe of the quotient obtained is $1 \cdot 77 \times 10^7$, *i.e.* considerably less than the $1 \cdot 86 \times 10^7$ obtained by Kaufmann.

WE have received a copy of the "Guide-annuaire de Madagascar et Dépendances" for the year 1908. This official publication contains a complete list of Government officials in the various provinces of Madagascar, and much valuable statistical information.

WE have received from Messrs. John Wheldon and Co., of Great Queen Street, London, a copy of a catalogue of 800 books and papers on cryptogamic botany which they offer for sale. The books are catalogued alphabetically by authors' names under the headings algæ, fungi, lichens, musci and hepaticæ, filices, and general.

MESSRS. SPOTTISWOODE AND CO. have sent us a copy of the autobiography of the late Sir Edward Frankland, which was edited and concluded by his two daughters, and printed for private circulation in 1902, under the title "Sketches from the Life of Edward Frankland." Copies of this interesting volume may now be obtained from Messrs. Spottiswoode at the prce of 3*s*. 6*d*. net.

THE first two numbers have reached us of *Pathologica*, a new monthly journal devoted to pathology, and having a strong editorial committee. The journal includes original articles, abstracts of recent publications, and reviews of books; it is published by Luigi Griffini, Genoa.

OUR ASTRONOMICAL COLUMN.

WATER VAPOUR IN THE ATMOSPHERE OF MARS.—A telegram from Prof. Lowell, published as Circular No. 105 of the Kiel Centralstelle, reads as follows:—"Quantitative measures by Very, with his new spectral comparator, of Slipher's spectrograms Mars mmron (?), show little *a* water vapor band twenty-two per cent. stronger in Mars spectrum than in our own air. Solar lines C equal.—Lowell."

Our readers will remember that early in the present year Mr. Slipher photographed the spectrum of Mars in which the *a* water-vapour band was considerably stronger, relatively, than in a similar spectrum of the moon, both spectra being taken when the objects were at about the same altitude (see NATURE, vol. lxxvii., No. 2002, March 12, p. 442). It is to these photographs, presumably, that the above message refers, the queried word probably meaning "moon."

ACCELERATION OF MATTER IN THE TAIL OF MOREHOUSE'S COMET.—In a paper published in No. 22 of the *Comptes rendus* (November 30, p. 1033), MM. Baldet and Quénisset give further details concerning the accelerating velocities of the agglomerations seen, on their photographs, in the tail of comet 1908*c*.

Between September 17 and November 6 ninety-six photographs were obtained, with six different cameras, at the Juvisy Observatory, and, on examining these, it is quite possible to recognise the same features of the tail on photographs taken at different times on the same night and also on those taken on successive nights.

The photographs taken on October 15 and 16, with an interval of nineteen hours, afford a good example. Measures made on that of October 15 showed that a luminous mass, then some 580,000 km. from the head, was travelling at a velocity of about 14 km. per sec. The same mass was easily recognisable on the photograph of October 16, and the measures showed that it was then about 2,200,000 km. from the head, that is to say, it had travelled 1,600,000 km. during the interval; had 14 km. been maintained as a uniform velocity, the distance covered would have been only 960,000 km. Measures made on two plates taken on October 15, with an interval between the exposures of 1h. 40m., showed that another similar luminous mass was travelling at the velocity of 58 km. per sec.

Other peculiarities in the tail are also noted, and in one of the two photographs which accompany the paper there is a remarkable deflection in the tail, not far from the head, which seems to indicate that the ejected matter had encountered some such obstructing medium as would be provided by meteoritic débris.

The peculiar changes of the comet's appearance are also reviewed by Prof. Barnard in No. 4, vol. xxviii., of the *Astrophysical Journal* (p. 292, November). With three cameras, Prof. Barnard secured 190 negatives, which show very strikingly how rapidly the enormous changes in the comet's appearance took place. Two photographs reproduced with the paper were taken on September 30 and October 1 respectively, the interval between the exposures being barely twenty-four hours; yet the general appearance of the tail was utterly transformed during that interval.

CHARACTERISTICS OF THE SUPERIOR (K_3) LAYER OF THE SUN'S ATMOSPHERE.—In a paper published in No. 22 of the *Comptes rendus* (November 30, p. 1016), M. Deslandres states that by employing a large spectroheliograph of a special type he has succeeded in obtaining photographs with the pure radiation (K_3) of the highest layer of the sun's atmosphere. In previous work the calcium radiation, K_3 the central dark reversal of the calcium K line—has always been mixed with varying proportions of the bright (K_2) reversals which bound it on either side, consequently the photographs have shown the integrated phenomena of the highest layer and the layer immediately below it; but in the new photographs those phenomena peculiar to the upper layer are shown alone. The favourable weather of the last four months has permitted a fine set of such photographs, extending over four rotatinns of the sun, to be obtained.

The principal characteristic of the K_3 images is the appearance of the long dark lines, which M. Deslandres has called *filaments,* joined up by the less conspicuous and less continuous lines designated *alignements*; these apparently intersect at particular points, three or four of them cutting each other in the same place. Then there are large, dark patches, some of which appear to lie above faculæ, whilst others are either attached to filaments or are independent.

Some of these filaments have been observed to persist in the same heliographic positions for several rotations, just as do spots in the lowest level, and this leads to the suggestion that spots and filaments are simply manifestations of the same cyclonic motions in different parts of the circulation. The analogy to terrestrial cyclonic movements is shown to be very close, and it is suggested that the closer study of the solar may throw valuable light upon the working of the terrestrial *tourbillons.*

Liverpool Astronomical Society.—The report of the Liverpool Astronomical Society for the session 1907–8 contains a number of papers read by various members during the session; amongst them is the president's address, in which Mr. Plummer gave an interesting description of the motion of Halley's comet and the various methods by which it has been investigated. Papers were also read by Mr. Reynolds, describing the large reflector which he has set up at Birmingham and also the one he presented to the Helwân Observatory, and Father Cortie, whose discourse dealt with the maintenance of the sun's heat.

One Hundred New Double Stars.—Bulletin No. 144 from the Lick Observatory is devoted to a list of 100 new double stars discovered by Dr. R. G. Aitken. This is the thirteenth list of its kind, bringing the total number of "Aitken" doubles to 1900, and it includes closer companions to the previously known doubles Σ 22, Σ 339, OΣ (App.) 41, OΣ 87, S. 461, β 627, and Σ 31.

PRIZE AWARDS OF THE PARIS ACADEMY OF SCIENCES FOR 1908.

At the annual meeting of the academy, held on December 7, the president announced the prize awards as follows:—

Geometry.—The grand prize of the mathematical sciences is divided in equal parts between Luigi Bianchi and C. Guichard; the Francœur prize is awarded to Émile Lemoine, for his work taken as a whole; the Poncelet prize to Prof. Fredholm, of Stockholm, for his researches on integral equations.

Mechanics.—The Montyon prize (mechanics) is awarded to E. Lebert. No memoir was received by the academy on the subject proposed for the Fourneyron prize (the theoretical or experimental study of steam turbines).

Navigation.—The extraordinary prize for the navy is divided between M. Labeuf (2500 francs), for his work on submarines, M. Dunoyer (2500 francs), for his electromagnetic compass, and M. Dautriche (1000 francs), for his work on the influence of alkaline salts on the power of explosive materials; the Plumey prize is divided between M. Codron (1500 francs), for his work on machine tools, M. Marchis (1500 francs), for his work on the use of poor gas and the production and application of low temperatures, and MM. Fortant and Le Besnerais (1000 francs), for their memoir on the oscillations of water along a vertical wall.

Astronomy.—The Pierre Guzman prize is not awarded. The Lalande prize is divided between W. L. Elkin and F. L. Chase, for their researches on the determination of stellar parallax, M. F. Smith receiving a mention; the Valz prize is awarded to Michel Luizet, for his researches on terrestrial magnetism, atmospheric electricity, and variable stars. No memoir has been received on the subject proposed for the Damoiseau prize (the theory of the minor planet Eros based on known observations). Pierre Puiseux receives the Janssen prize for the whole of his astronomical work.

Geography.—The Gay prize is divided unequally between Louis Gentil, for his topographical and geological work in Morocco, Prosper Larras, Abel Larras, and Marcel Traub, for surveying work in the same country; the Tchihatchef prize is awarded to Lieut.-Colonel Bernard, for his memoir on the delimitation of the Franco-Siamese frontier; the Binoux prize is divided between Paul Heilbronner, for his memoir on the geometrical description of the French Hautes Alpes, and Jules Richard, for his works and book on oceanography. Mentions are attributed to MM. Mazeran and Réne Bossière. The Delalande-Guérineau prize is awarded to Auguste Chevalier, for his researches on the flora and economical resources of tropical Africa.

Physics.—André Blondel receives the Hébert prize, for his researches on the electric arc; Marcel Brillouin the Hughes prize, for his book on the viscosity of liquids and gases.

Chemistry.—The Jecker prize is awarded to Ph. Barbier, for his researches in organic chemistry; the Cahours prize to MM. Gain and Pierre Carré (in equal parts); Montyon prizes (unhealthy trades) to A. Frois, for his work on dust arising in industrial occupations, and Georges Claude, for his practical applications of liquid gases; the Berthelot prize to M. Fosse; the Fontannes prize to M. Pervinquière; the Bordin prize to F. Priem and M. Leriche.

Botany.—The Desmazières prize is not awarded, but M. Hariot and Mlle. Belèze receive honourable mentions; the Montagne prize is awarded to Ernest Pinoy, for his studies in the myxomycetes; the De Coincy prize to Paul Guérin.

Anatomy and Zoology.—For his work on the Coleoptera, Pierre Lesne receives the Savigny prize; Jules Bourgeois the Thore prize, for the whole of his entomological work.

Medicine and Surgery.—Montyon prizes are awarded to MM. Frouin, Tissot, Carré, and Vallée, and MM. Rennes, Chevassu, and Joly are accorded mentions, MM. Georges Rosenthal, Adrien Lippmann, and Soubies citations. The Barbier prize is awarded jointly to MM. Piettre and Vila, for their work on the blood of mammals and birds; the Bréant prize (interest, in equal parts) between MM. Vincent and Remlinger; the Godard prize to MM. Lamy and Mayer jointly, for their studies on the mechanism of urinary secretion; the Baron Larrey prize to Dr. Bonnette, for his memoir on the dangers attending the use of blank cartridge; the Bellion prize to M. Basset, for his book on pathological anatomy, J. Alquier receiving an honourable mention. The Mège prize is not awarded. The Serres prize is accorded to Albert Brachet, for the whole of his work on embryogeny.

Physiology.—The Montyon prize for experimental physiology is divided equally between J. Sellier, for his studies on the comparative physiology of digestion, of muscular contraction, and the special physiology of the encephalus, Henri Pottevin, for his studies on the soluble ferments, and F. X. Lesbre and F. Maignon (jointly), for their contributions to the physiology of the pneumogastric and spinal nerves. The Philipeaux prize is awarded to M. Lafon, for his experimental researches on diabetes and glycogen; the Lallemand prize to G. Pagano, for the whole of his researches on the nervous system; the Martin-Damourette prize to Eugène Collin, for his application of the microscope to the determination of substances of vegetable origin; the Pourat prize to J. Lefèvre, for his studies on the energetics of the animal body.

Statistics.—The Montyon prize is divided between MM. Deniker and Felhoen, MM. Risser and Laurent receiving mentions.

General Prizes.—Berthelot medals are awarded to MM. Barbier, Gain, Pierre Carré, Frois, and Georges Claude. Charles Frémont receives the Tremont prize and J. H. Fabre the Gegner prize. The Lannelongue prize is divided between Mmes. Béclard, Ruck, Cusco, and de Nabias; the Wilde prize between MM. Tikhoff and Charles Nordmann; the Saintour prize between Paul Gaubert and Émile Rivière; the Jérome Ponti prize between Louis Bedel and Adrien Dollfus; the Houllevigue prize between MM. Debierne, Petot, and E. Fabry. The Estrade Delcros prize is awarded to Jacques Hadamard; the prize founded by Mme. la Marquise de Laplace to P. M. E. Lancrenon; and the prize founded by M. Félix Rivot to MM. P. M. E. Lancrenon, G. E. A. Chavanes, and R. D. Blanchet.

METEOROLOGY IN SOUTH VICTORIA LAND.[1]

WHEN the *Discovery* sailed for the Antarctic regions in August, 1901, Captain Scott took out an equipment of meteorological instruments, but the men who were to have used them were not on board. When South Victoria Land was reached, the observations, therefore, had to be made by men who had not been trained for the work. The report on the observations which were made by Lieut. C. W. R. Royds and assistants shows that they are to be congratulated on their success in carrying out arrangements for the exposure of the instruments and their devotion in maintaining the readings during their stay in South Victoria Land.

The first volume of the report contains the observations made at the winter quarters of the *Discovery* at Ross Island, and also those made on sledge journeys from there at various times during 1902 and 1903. These have been examined and tabulated at the Meteorological Office under the direction of Dr. W. N. Shaw, and have been discussed in sections by Commander Campbell Hepworth, Mr. R. H. Curtis, Dr. C. Chree, F.R.S., Mr. W. H. Dines, F.R.S., and Mr. C. T. R. Wilson, F.R.S. The preface is by Dr. W. N. Shaw, and Lieut. Royds has written the introduction, giving details as to the exposure of the instruments.

The *Discovery's* winter quarters were in lat. 77° 50′ 50″ S. and long. 166° 44′ 45″ E., and observations were made every two hours from February 9, 1902, to February 15, 1904. Whilst the *Discovery* was at Ross Island it was remarkable how infrequently did the thermometers register temperatures above freezing point, the maximum reading being only 42° F. The lowest reading was −58°·5 F. Yet it is noted that the ship was in a position much warmer than the regions surrounding.

The fluctuations of the temperature were rapid and violent, and generally associated with a change of wind direction. A south wind often brought a rise of temperature. The alcohol minimum thermometer was read and re-set every two hours, and when the observations were compared with the readings of the adjacent mercury thermometers the fact was brought out that there was a minimum in almost every two-hour period, and the thermograph readings also show this.

The summers were notably cold; the highest mean temperature for any month was 26°·2 F., this being the mean for December, 1903. The coldest month was July, 1903, the mean temperature being −21°·0 F. These are the values given in the preface and in one of the tables, but there are two other tables which give different months and temperatures. During April, 1903, the temperature never exceeded 0° F.

Discussing the readings of the minimum thermometer, it is shown that the lowest readings of the day oftenest occurred within two hours of midnight. A table is given showing the percentage frequency of the occurrence of the minimum of the day in each two-hour period. These values are given monthly and seasonally. On 37 per cent. of days the principal minimum occurred between 10 p.m. and 2 a.m. The values for the winter season show the maximum frequency at this period of the day, and also a secondary maximum between noon and 2 p.m., the minimum occurring at 8 a.m. to 10 a.m. being the principal one.

This table is put forward as very strong evidence that during the Antarctic winter night the temperature is affected by diurnal and semi-diurnal influences. The mean daily variation of temperature amounts only to 3° in summer and 1° in winter.

The sunshine recorder was not set up until September 14, 1902, and there is no record after February 15, 1904. The amount of sunshine recorded is remarkably great. In December, 1903, 490 hours were registered, this being 66 per cent. of the total possible. There were several notable spells of continuous sunshine; thus in December, 1902, there was a period of eighty-seven hours' unbroken sunshine, and in December, 1903, one of seventy hours. During the twelve days December 6–17, 1903, there were only fifteen hours without sunshine.

The amount of cloud was observed and recorded 7890 times. Less than one-tenth of the sky was occupied by clouds in 37·5 per cent. of the cases; 43 per cent. of the observations record that more than eight-tenths of the sky were clouded. The winter months were least cloudy.

FIG. 1.—Map of south-western extremity of Ross Island, showing winter quarters of H.M.S. *Discovery*.

Although the readings of the wet- and dry-bulb thermometers were recorded, the values for humidity have not been tabulated, as it is the opinion of meteorologists that the relative humidity values obtained from very low thermometer readings are much open to doubt. The data are, however, sufficiently definite to show that the climate of Ross Island is undoubtedly very dry.

Observations with a black-bulb thermometer *in vacuo* gave remarkable results in the form of high readings. Thus for the month of December, 1902, when the mean temperature was 23°·1 F., the average maximum on the black bulb was 123° F., and in January, 1903, only on one day did this thermometer fail to register 100° F. It is argued that the air over the Antarctic regions must be

[1] "National Antarctic Expedition, 1901–4." Meteorology, Part i., Observations at Winter Quarters and on Sledge Journeys, with discussions by various Authors. Pp. xiv+548. (London: Royal Society, 1908.)

very permeable to solar radiations, and that this is due to the small amount of aqueous vapour present.

During the two years under discusison no rain fell on Ross Island. The measures of snowfall are somewhat doubtful, and were obtained by driving stakes into the snow and measuring at intervals the length exposed. The only point that is definite is that the total fall for the two years must have been very small.

Observations on the amount of evaporation were made during the winter by weighing small dishes of ice daily, the ice having been formed in the dish so that the surface was smooth and measurable. Notwithstanding the very low temperatures of the winter months, the evaporation was very great, the mean monthly value being 0·25 inch, which is almost double that for the winter months in London, where the temperature is nearly 50° higher. These observations confirm the opinion expressed as to the low humidity indicated by the wet- and dry-bulb thermometer readings.

The observations on wind direction, when reduced to eight points, show 8 per cent. of north winds, 5 per cent. of south winds, 61 per cent. between north and south on the east side, and 3 per cent. on the west side; 23 per cent. of the observations recorded "calms." The observations at Cape Armitage, 3000 yards away, agree with this.

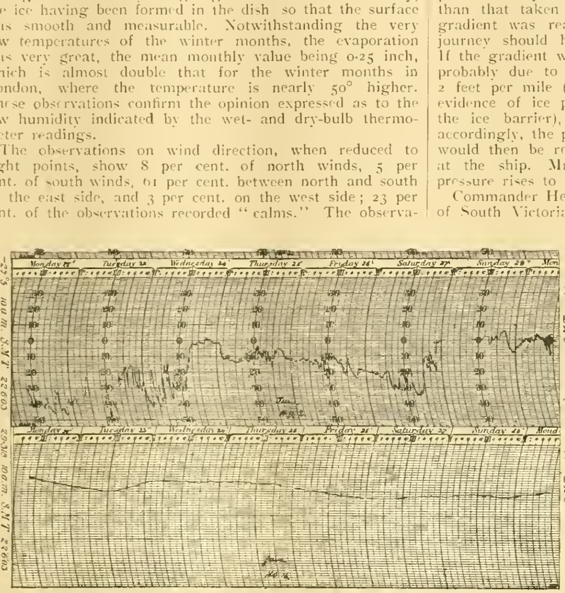


FIG. 2.—Reproductions of traces of the self-recording instruments at winter quarters, representing rapid fluctuations of temperature and an associated barometric trace. (1) Thermograph record of temperatures between −50° F. and 5° F., June 22 to 28, 1903. (2) Barograph record for comparison showing the absence of any noteworthy change of pressure to correspond with changes of temperature.

On the sledge journey made by Lieut. Royds and party to the south-east, across the Great Ice Barrier, observations of wind direction were made, but the rough notebook does not say whether the directions entered are "true" or "magnetic." Lieut. Royds afterwards wrote that they are "true" bearings, and indicate south-west winds. In the discussion by Mr. Curtis they are treated as doubtful, and as possibly easterly winds. The records of other sledge journeys often show southerly or south-westerly winds.

The direction of movement of lower clouds was in 47 per cent. cases between south-east and south-west; of Mount Erebus smoke, 76 per cent. cases between south and west; of upper clouds, 64 per cent. cases between south-west and north-west.

The mean barometric pressure during the period February, 1902, to January, 1904, was 29·29 inches, and comparing this with the observations made on other expeditions, and bearing in mind the prevalence of easterly winds at the ship's station, it is deduced that the barometric pressure should be relatively higher over the regions towards the Pole.

In this connection the observations made on the various sledge journeys become important, though in the discussions of them Mr. Curtis and Commander Hepworth reach different conclusions.

Mr. Curtis, discussing the observations of pressure made by Lieut. Royds on his journey across the Barrier in November, 1903, plotted them on a distance scale, reading to and from the ship, and apart from the general fall on the outward journey and the rise on returning, recognises points which seem to indicate fairly definitely changes in altitude. The reading taken at the furthest point of the journey (170 miles) was about 0·25 inch lower than that taken on the ship at the same time. If this gradient was real, then the winds experienced on the journey should have been stronger than were recorded. If the gradient was not real, then the difference was most probably due to change of altitude. Assuming a rise of 2 feet per mile (an amount apparently warranted by the evidence of ice pressure and the northerly movement of the ice barrier), and reducing the barometer readings accordingly, the pressure at the last station on the journey would then be read as one-tenth of an inch greater than at the ship. Mr. Curtis concludes, therefore, that the pressure rises to the south.

Commander Hepworth, in his memoir on the climatology of South Victoria Land, makes a long and careful comparison of the observations made by all the Antarctic expeditions and on excursions from Ross Island. Attention is often directed to pronounced differences between the weather experienced by the sledge parties and that prevailing at the *Discovery*. Wind, temperature, and pressure all differ, and Commander Hepworth finds sufficient justification for accepting Lieut. Royds's statement that the winds on his journey across the Barrier were south-westerly.

Captain Scott in his book, "The Voyage of the *Discovery*," says, of another excursion, "on comparing notes with this party we realised for the first time what a difference there might be in the weather conditions within easy reach of the ship. It was not only in the matter of temperature—as I have already described—but also in the force and direction of the wind. . . . Already we had learnt that the prevalent wind at our winter quarters blew from the south-east through the Gap, and that this wind was usually local and frequently ceased within a mile or two from the ship."

Commander Hepworth says that in correcting the observations of pressure made on sledge journeys he has assumed a mean altitude, whilst "it is recognised at the same time that the assumption of a mean altitude is scarcely admissible, as the whole mechanism of ice distribution implies some gradual elevation southwards—how much is an open question."

By this method of correction "the results show that the mean pressure to the south differs but little from the mean pressure at the winter quarters."

"It seems not improbable that indeed from Cape Adare to Mount Longstaff and even still further to the south, the distribution of pressure conforms largely to the configuration of the high land, and that an area of relatively high pressure lies over the land to the westward of the coast ranges and relatively low over the Ross Sea, giving gradients for southerly winds during the greater portion of the year."

The existence of the Antarctic anticyclone is not yet proved, though many facts point towards it.

Some of the differences between the results arrived at by those who have discussed the observations are certainly due, to some extent, to imperfections, some of them inevitable, in the observations themselves, but it seems probable that if the statements made by certain members of the expedition had been accepted, as they should have been, some of these differences might have disappeared.

M.

THE PERCY SLADEN TRUST EXPEDITION TO THE INDIAN OCEAN. FURTHER EXPLORATIONS.[1]

To complete the work of the above expedition I left in June last for the Seychelles, accompanied by Mr. H. Scott and Mr. J. C. F. Fryer as naturalists. We arrived there on July 10, but were unfortunately detained on Long Island, the quarantine station, for ten days. The time, however, was by no means wasted, as the island was fairly representative of low-country coco nut cultivation, and contained a fairly rich insect fauna, mainly of introduced species. We had boats also, and were thus enabled to examine the reefs in its vicinity, collecting particularly the sedentary organisms.

On July 23 I sent Mr. Fryer to examine Bird and Dennis, two islands seventy miles to the north of Mahé, on the edge of the Seychelles Bank. He remained a fortnight on each, examining them in all their aspects. The former was barren, with a vast number of sea birds breeding upon it, while the latter was planted in coco nuts. Both proved to be formed entirely of coral material, rock and sand, and both were found to be gradually washing away into the sea. The surface reefs around them are insignificant, and they gave the impression of being the remains of reefs once widely extending along the north edge of the whole bank. On his return Mr. Fryer at once started down to visit the islands of Aldabra, Assumption, Cosmoledo, and Astove, among which he is to work for four months. These islands lie to the north-west of Madagascar, and due west of Farquhar Atoll, visited by the *Sealark* in 1905. Assumption and Aldabra form the most western group, the former being a crescent-shaped bank, 3½ miles long, and the latter a ring-shaped atoll, 19 miles long by 7 miles across, almost completely surrounded by land, with a shallow lagoon.

Astove and Cosmoledo form a second group, the former a ring-shaped atoll, 2 miles long, completely surrounded by land save for one passage to the south, and the latter an atoll, 9½ miles by 7 miles, lagoon 4 fathoms, ring much broken up, with eight main islands. Aldabra is well known as the home of gigantic land tortoises. Some rock from it in my possession contains *abundant* silica, a fact which makes the accompanying abstracts from Mr. Fryer's preliminary report on its adjacent islands of peculiar interest.

On July 24, accompanied by Mr. Scott, I went to Silhouette, the second highest island in the Seychelles, 2467 feet. We settled at 1600 feet, within the indigenous jungle, of which a square mile still exists. Here Mr. Scott remained until October 1, obtaining a rich collection of its insect fauna, which, allowing for the difference in the size and position of the islands, appeared to be to a large degree comparable in its nature to that of the Sandwich Islands. The island itself is about 12 square miles in extent, with rugged granite hills, and two bays with flats covered with coco nuts. These owe their existence to former fringing reefs, the level of the island having changed to the extent of at least 30 feet within comparatively recent times. The coco nut is grown up to 1200 feet, but the trees, as is also the case in Mahé, are infested with a fungoid disease, and do not bear well.

After a month in Silhouette I returned to Mahé, every part of which I visited in the ensuing seven weeks. For the most part I was occupied in examining its geographical features, rocks, reefs, and jungles, and in collecting its plants, of which I obtained upwards of 2000 sheets. I have little of general interest to add to my report in NATURE, January 25, 1906. Mahé showed the same change of level as Silhouette, and my former impression, that there might have been a more ancient elevation of about 200 feet, proved to be erroneous. Only about 2½ square miles of the indigenous jungle are now left, and that is being gradually affected by the reckless destruction of its larger trees. Mr. Scott is to collect its insects during the next four months, but it can scarcely be supposed that more than a small percentage of its indigenous fauna still manages to survive. This jungle area lies in the centre of the island, the north and south thirds of which, being almost completely deforested, have become physiologically dry, to the almost complete destruction of their indigenous flora and fauna. Much of the land, too, has been destroyed by cassava planting, which is followed on the steep hill-sides by the washing away of the soil, converting them into bare glacis.

J. STANLEY GARDINER.

Astove, where we arrived first, is an atoll about 2 miles long by 1½ miles broad; so far as I could tell it is entirely composed of elevated coral as a basis, with sand distributed in various places. The seaward beach in most parts is formed of sand, but in places coral rock forms small cliffs, showing very evident washing away. There is only one pass. This is narrow, and from the present rate of washing away must be of fairly recent date. On the westward side of the pass are "coral rock" cliffs, while on the east a good deal of piling up of big blocks has occurred. These blocks are all of coral rock, not dead corals. They appeared to have come partly from the present land (washed out) and partly from the reef, which, so far as I could see, was composed of coral rock only, and was not ordinary dead reef such as I saw at Bird Island, to the north of the Seychelles. The coral rock interested me very much. In places one could see regular fields of coral with all the corals in their natural positions, while here and there are small holes, 5 feet to 6 feet deep, with sides all encrusted with corals exactly as they grew. There was absolutely no question of piling up. The whole place is evidently exactly as it was underneath the sea. In parts of the island the corals have been more "metamorphosed" into rock (not retaining their original structure), but I could trace no correlation between the occurrence of this rock and its position on the island. In the north of the island there are some dunes about 50 feet high, purely of wind formation. I dug a hole on the landward side of one, and found guano underneath with a sort of shingle below. I think the north-west monsoon must have been much stronger once, or cyclones more frequent, to have driven this shingle inland.

The lagoon is very shallow: bottom of fine coral (?) mud, which makes the whole lagoon white, and forms a froth all round the shore. There are one or two small islands near the pass. There will probably be two more "passes" formed soon, one to the N.N.E. and another to the S.E. The reef to the west is sandy, with little living coral. It falls directly to "no bottom" without any slope, so that a ship cannot anchor, but is moored by lines to the reef. I searched the reef opposite the pass, but found no living corals, only a piece or two of recently killed coral thrown up. As I have said before, it is rock, and not reef. In one place it drops to the sea in terraces, forming small waterfalls as the tide goes out.

The next island we went to, Cosmoledo, represents a further stage in the Astove condition. There are only a few islands left. The settlement is on Menai, with a fishing station on Wizard. The rock is the same as at Astove, but naturally there is very much more sand. All round the reef the remains of islands stick up like rock mushrooms. On Menai Island there is a mangrove swamp on the lagoon side, trees mostly small, as the larger have been cut for their bark, used for tanning. There is a sand-dune, with some very old Casuarina. Everything was very dead and burnt up, and not nearly so attractive as at Astove. I went also to Wizard, Goëlette, and North-East Islands. Wizard is very sandy, but has the distinction of having three good wells. I got a positive measure as to the rate of erosion, 15 yards having gone in the last fifteen years (measured by Spur's old house, which is now in the sea). Goëlette is of no interest except as containing some guano; North-East Island I only stayed on for a short time; all the guano has been dug, and is now being taken to the Cape. I caught a large lizard there, which occurs on none of the other islands, but it seems to me to be only a variety of the universal small one. We had wretched weather, very squally, and I seem to have spent most of my time in a whale-boat trying to get to somewhere.

The next island, Assumption, is the most interesting of the three; it is not an atoll, and the settlement is a new one, so that everything is untouched. The rock is

[1] For earlier reports see NATURE, April 13, August 10, October 5, November 9, December 21, 1905, and January 25, 1906.

the same as at the other islands, but is more changed, and possibly contains some mineral other than calcium. The most interesting feature was the presence of big pits, some very deep, all over the island. The rock seems to be honeycombed with holes, sometimes covered in and sometimes open through the falling in of the superficial layer. Further, in three of these pits I found mangroves growing, all of very great age. Two contain Brugiera and one Ceriops. I thoroughly explored all these holes, digging where possible. In one mangrove hole the bottom was guano; I dug 18 inches, but water came in so quickly that we could go no further. The water was salt. The crowbar showed at least 5 feet more "guano mud." The hole was about 8 feet deep, and so there must have been at least 13 feet altogether. There was plenty of mangrove (Brugiera) seed, but very few young trees. This hole was on the eastward side of the island, near the sea. In another hole, just west of the centre of the island, the trees were also Brugiera. This hole was very deep (25 feet to 30 feet), with pools of brackish water (undoubtedly from the sea). Digging again was hopeless, and the crowbar found no bottom. I found some shells in the mangroves, most of which were dead. In another hole (north of the island) there were Ceriops trees. The hole was 12 feet deep, the bottom wet and muddy, salt water standing on one side (and fluctuating with the tide). We tried digging here with more success, the water coming in from the sides, and not the bottom. We got down two holes 15 feet, and then found a great lump of coral, which the crowbar broke off. The water got so high that I could not tell whether this was a coral lump tumbled off the walls and fallen by chance in a natural position, or whether it was the bottom of the hole. So I dug another hole, and at a depth of 6 feet came to a soft, white ooze rock; how much of it there was I do not know, as we could only grovel for bits broken off by the crowbar in 4 feet of mud and water. How the mangroves got into these pits I cannot imagine. There is certainly nothing more than a free percolation from the sea. The only suggestion I have is that there have been two elevations, and that after the first the island was only a foot or two out of the water, possibly with protecting sand round the edge, and that it was covered with mangroves.

In one hole I found the remains of land tortoises, which are certainly extinct now. Is there any historical evidence?[1] I send all I could find to try and ascertain the species, or rather to see if it is the same as the Aldabra one. I also send some things found by the manager in the guano which look like eggs of these tortoises. I heard that the same had been found also at Cosmoledo.

The deepest hole was 45 feet deep, and contained 23 feet of water, which in all cases was salt. I tried to think if a lagoon formation could take place this way, but do not quite see it yet. The holes are certainly increasing in size owing to erosion and weathering, but must at the same time get shallower. There are some high dunes, 70 feet, at the south-east; wherever there is sand on the east of an island a dune is formed; as a rule, however, this side is bare rock, as the sea is very heavy, and keeps it clear of sand.

The vegetation of Assumption differs slightly from that of the other islands in that there are numbers of tanghain (*Euphorbia abbotti*) and la fouche (Ficus) trees, which give the land a different appearance. Of animals, I caught two species of bat, from which I got some Nycterobia.

J. C. F. FRYER.

[1] No.—J. S. G.

THE ORIGIN OF THE POTATO.

IT is a curious fact that the origin of the potato of commerce, *Solanum tuberosum*, that is, the wild species from whence it was derived by selective cultivation, has hitherto baffled research, none of the many wild species of that genus agreeing sufficiently closely in character to be identified with any of the innumerable varieties existing. This in itself might have been of little importance had not the outbreak of the potato disease in the last century suggested the wisdom of finding the original wild species, and by crossing it with the cultivated forms, of infusing fresh vigour into the latter, and thus to some extent fortify them against that destructive plague. To this end Mr. A. W. Sutton, of Reading, collected as many of the wild species as he could from the native habitats in Chili and Peru, and also from outside sources in North America and elsewhere, but none of these could be accepted as the parental form of the potato of commerce, and though many experiments were made in the way of hybridisation, the results were entirely negative so far as obtaining an improved strain was concerned, and the trials consequently ceased.

A fresh impulse was given to Mr. Sutton's researches by the alleged appearance in France of a "sport" from a wild species known as *Solanum commersonii*, which "sport" was declared to be fully equal to good varieties of the potato of commerce, though it had arisen, as the presumed raiser asserted, from a tuber of the wild species named. Not only, however, did this "sport" resemble closely a cultivated potato in all its characters, but investigation proved to all practical potato growers and experts that it was identical with a well-known variety, and that, in point of fact, it must have originated from a tuber or part of a tuber of that variety which had accidentally been in the soil in association with the wild tubers. The renewed research to establish this fact had, however, the result of re-directing Mr. Sutton's attention to another wild species called *S. etuberosum*, which had been grown in Mr. Sutton's ground for some twenty years, but which until 1906 had not been observed to produce any seedberries, and had consequently not lent itself to seminal culture, but during that period its tubers, originally small and about the size of marbles, but white and edible, had increased to 2 inches to 3 inches in diameter, and when cooked resembled closely an ordinary potato. In 1906, however, one seedberry was observed, and the opportunity of sowing was immediately seized upon. Hitherto all the recognised wild species when sown yielded true offspring, that is, no variation at all was observed, and Mr. Sutton's surprise may therefore be judged when the twenty plants produced from this seedberry were not only of very varied character in foliage, flowers, and tubers, these last being of many colours and shapes, but they were diverse on precisely the lines of a batch of seedlings of the common potato, from which, indeed, they could not be discriminated even by an expert. The idea consequently arose that this might be due to cross-fertilisation with one of the ordinary potatoes in the vicinity, and though Mr. Sutton's experience led him to doubt this, he proceeded to check these results by a second sowing in 1908 from several seedberries which had been successfully self-fertilised by hand, and were consequently free from suspicion. The resulting plants, however, were equally diverse, and on the same lines. A second suggestion was then made that the parent plant, *S. etuberosum*, was not really a wild species, but an escape from cultivation; but here, apart from the original smallness of the tubers, the botanist steps in, for all the wild species examined have pollen grains of a symmetrically oval or elliptical shape, and *S. etuberosum* has them of same form, while all pollen grains examined of cultivated potatoes are extremely irregular in size and shape, and no true elliptical ones are seen. The true specific character of *S. etuberosum* is thus established, while the identity of its offspring with that of the commercial potato equally establishes the fact of its being the original wild species.

Finally, a most important economical fact remains to be mentioned. For more than twenty years *S. etuberosum* has entirely defied the potato disease in the Reading grounds, though year after year subjected to infection by closely adjacent plants. The result originally aimed at when the experiments commenced is thus more than achieved, since there is no necessity for cross-fertilising with the ordinary potato, which is susceptible to disease, and consequently we have all the vigour of the wild type without any taint whatever in the new strain of disease-proof or disease-resisting potatoes which, it is hoped, has now appeared.

CHAS. T. DRUERY.

RADIO-ACTIVE CHANGES IN THE EARTH.[1]

I WISH particularly to refer to manifestations of radio-activity which are observed, not in artificially prepared materials like radium, but in the rocks and minerals of the earth's crust, as we find them in nature. Let us consider, in the first place, the most conspicuous cases of this kind. The source from which radium is obtained is the mineral pitchblende. This mineral occurs in veins, like the majority of the useful metals; I may refer particularly to the mineral veins of Cornwall, so long famous as a source of tin. These veins are of the nature of cracks, running through the granite and through the slate which adjoins it. The cracks have been filled up by the various metallic ores which have been introduced by precipitation or sublimation, the exact nature of the process being somewhat obscure.

I will now show you an experiment, due to Sir W. Crookes, which illustrates the radio-activity of pitchblende in a very beautiful manner. A flat polished slab of pitchblende intergrown with a variety of other material which is not radio-active was laid face to face with a photographic plate, which was developed after the lapse of about a week of contact. The radium and other radio-active substances contained in the pitchblende have acted photographically upon the plate, while, of course, those portions of the material which are not radio-active have exerted no such action. Thus pitchblende has, as it were, taken its own portrait, which I now show you on the screen.

Pitchblende, the principal radium ore, contains, as you know, only an infinitesimal percentage of radium, the bulk of the substance being made up of oxide of uranium. Uranium is commonly spoken of as a rare metal; but terms of this kind are comparative only, and in contrast with radium, which is more than a million times scarcer, it seems common enough. Now I wish to speak for a little about this association of uranium and radium in pitchblende. Is it accidental, or has it some special significance? I hope to be able to convince you that it has.

In the early days of radium it was common to hear the difficulty emphasised that while there was no reason for doubting that the radium which was found in the earth had been there as long as other metals, a substance that was continually giving out energy in this way was obviously defying the greatest physical generalisation of the nineteenth century the law of the conservation of energy. We cannot, however, afford to sacrifice this law so easily, and a ready mode of escape offers itself if we suppose that a continual waste of radium is occurring. In that case it becomes necessary to suppose, also, that the supply is in some way replenished, for otherwise all the radium would have wasted long ago. From what material are the fresh supplies of radium derived? They must be derived from some other substance contained in the mineral where the radium is found, and there is now reason to feel sure that uranium is the substance in question.

We have convincing proof of this in the fact that the amount of radium found in the mineral is always in direct proportion to the quantity of uranium which it contains. I should perhaps say, to avoid misconception, that there is good reason for believing that several transitional stages exist through which uranium passes on its road to become radium. It is not necessary, however, to take into account the existence of these intermediate products in order to form a clear idea of the process by which the supply of radium is kept up. Uranium changes spontaneously, though very slowly, into radium, and the amount of radium produced per annum, for example, will be proportionate to the amount of uranium present. On the other hand, a certain fraction of the total amount of radium present decays per annum, and the balance of this account of profit and loss will represent the amount of radium found in the mineral at any time that we examine it. There will be no difficulty in seeing that on this theory the amount of the radium in the mineral should be proportionate to the amount of uranium, and experiment fully confirms the theory by showing that such is in fact the case. We have here a clear and distinct case of the transmutation of metals, so long unsuccessfully searched for.

Let us now come back to the pitchblende.

What was the source of metalliferous ores found in mineral veins is a very much vexed question, and no solution of it which has yet been proposed can be said to be altogether free from difficulty. One of the most plausible theories, however, supposes that the metals have been derived from the rocks by which the veins are traversed. We are not here concerned with metalliferous ores in general, but only with those which carry radio-active material. In deciding whether the granite of Cornwall can be supposed to furnish the uranium of pitchblende, it is, of course, fundamental to know whether any uranium is present in the rock. It should be said, by way of preface, that the quantity must, at best, be very small, and certainly too small for detection by the methods of chemical analysis as ordinarily applied. We have seen that uranium in nature is invariably accompanied by a proportionate quantity of radium, and as it is in practice much easier to detect minute quantities of radium than to detect the corresponding quantities of uranium, it is best to look for the former only, and to be content to infer the presence of the latter.

I have made a large number of experiments to find out how much radium there may be, not only in Cornish granite, but in a large variety of other rocks. In every case the presence of radium has been established, though only to the extent of about one-millionth part of what is found in pitchblende, and even that, it will be remembered, is not much. If we take into account the very large bulk of the granite and the very small bulk of the pitchblende veins running through it, there is no difficulty in admitting that the granite was capable of supplying the radio-active material of the pitchblende.

Granite, of course, consists of a variety of different minerals, which give it its mottled appearance. These minerals, there is no reason to doubt, have been formed in the successive stages of crystallisation of an originally molten mass. There is a mineral called zircon, of which the jacinths sometimes set by jewellers are a variety, which is present in very minute crystals in granite. These minute crystals of zircon have a very characteristic geometrical shape; a square prism terminated at each end by a pyramid. The fact that they have this perfect shape is a proof that they have been perfectly free to assume their natural form, and have not been hampered for want of space by other minerals surrounding them. The inference is plain that zircon has been one of the first minerals to crystallise in the consolidation of granite.

I have found that this zircon is very much richer in radium than the granite generally, though, on the other hand, it is poor compared with pitchblende. It seems clear that the minerals which crystallise first take an unfair share of the radio-active elements, leaving the rest of the magma impoverished.

In the light of this observation, Prof. Joly, of Dublin, has been enabled to explain a curious appearance which is seen when a section of the granite thin enough to be transparent is examined under the microscope. This appearance is seen in one of Prof. Joly's photographs of a minute crystal of zircon, which is embedded in a large crystal of mica. You will observe that the material surrounding the zircon for a definite distance outwards has become darkened in colour. The altered region round the speck of zircon is practically circular, and is reminiscent of a spot of grease on cloth.

Prof. Joly has pointed out that this alteration in the surrounding materials must be due to the radio-activity of the zircon. That radio-active materials are capable of producing such colorations has been known from the early days of radium. You see, for instance, projected on the screen, the image of a glass bottle, in which a radium preparation has been kept. Though originally of colourless glass, it has been stained a deep purple by long-continued action of radium.

It may, perhaps, be thought that this idea, though plausible, is no more than a guess. It is, however, much more than that. We know, from the investigations of Prof. Bragg and Mr. Kleeman, that the α particles of

[1] Discourse delivered at the Royal Institution by the Hon. R. J. Strutt, F.R.S.

radium, which constitute the most important feature of radio-active emission, are only able to penetrate a limited and definite distance into solid materials. They then lose their characteristic properties, if, indeed, they are not altogether stopped. This distance has been measured experimentally, and Prof. Joly has shown that the distance is just the same as that to which the alteration round the zircon crystals extends. Thus we have full quantitative confirmation of the theory which attributes it to radio-activity.

I will now pass from the discussion of a very minute phenomenon to the discussion of a large-scale one. It will be familiar to many of you that, in the opinion of some, at least there is reason for changing the views which have been held for two generations concerning the earth's internal heat. We know that there is, at any rate, some radium in the earth, and that radium gives out heat. Thus it cannot be disputed that some part of the earth's internal heat must be due to this cause; the only question which remains is whether this part is large or small, whether, in fact, the earth's internal heat is chiefly to be accounted for as a small remnant of the much greater internal heat which it once possessed, or whether there is enough radio-active material in the earth to supply most of the annual loss by conduction through the crust and radiation into space.

As I mentioned before, I have made a large number of determinations of the quantity of radium in the rocks of which the superficial portions of the earth are constituted. These are found to be so rich in radium that the difficulty is not so much to account for the internal heat of the earth, as determined by underground observations of temperature, but rather to understand why it is not much hotter. I have suggested, as an explanation, that this general distribution of radio-active material, which pervades the outer parts of the earth, is in reality superficial, extending only to some moderate number of miles in depth, though no doubt much deeper than the deepest mines. I am not wholly satisfied, however, of the sufficiency of this explanation. Radium, and the series of products of which it is one, are not the only radio-active materials in the earth; there is another series, of which thorium is a member, and there is good reason to suppose that thorium is present in rocks in such quantity as to add appreciably to the evolution of heat. Taking this into account, we should probably find, if we had exact data for calculation, that the thickness of rock containing radio-active material was so small that the material of the interior would somewhere have exuded, in the course of the violent dislocations and earth movements which geology reveals to us. No material, however, appears anywhere at the earth's surface which can plausibly be regarded as representative of the unknown interior if the suggested hypothesis is accepted. It cannot be denied that the subject is at present obscure. Possibly an explanation may be found by supposing that the activity of uranium may be arrested at high temperatures. We have at present no adequate experimental evidence on the subject. It is known that there is very little effect of this kind on radium. If, however, the activity of uranium were arrested at a high temperature, the supply of radium and all the other members of the series would fall off, and thus the aggregate heat production of the whole series might be greatly diminished.

I shall now pass to another branch of the subject. The investigations of Sir William Ramsay and Mr. Soddy have proved that there is continuous evolution of helium from the radium emanation. We have good reasons, into which, however, I do not propose to enter, for considering that the same is true of radio-active changes in general, at all events those in which there is an emission of radiation. Helium is probably evolved at each stage of the transformation of uranium, and at each stage of the transformation of thorium; and it results that the natural minerals and ores in which these elements are found contain a store of helium, which has accumulated in them and remains locked up in their pores.

As already mentioned, I have succeeded in determining the presence of radium in granite. Thus it becomes natural to inquire whether the corresponding amount of helium is to be found there too. Nothing of the kind had ever come under observation before, and it was, therefore, with some interest that I made the experiment. You see before you a vacuum tube of helium prepared from ordinary granite. The characteristic yellow glow will satisfy anyone acquainted with the appearance of a helium discharge of the presence of the gas.

The facility with which helium was detected in granite suggested further experimental problems. The undoubtedly radio-active elements are at present confined to uranium and thorium, and their respective families of descendants. Evidence has been produced, by myself among others, which suggests that lead and some other elements possess a feeble radio-activity of their own; but this evidence is somewhat equivocal. It seemed highly desirable to attack the question in a new way, and the idea suggested itself of looking for helium in the naturally occurring ores of all the elements, common and rare. This had indeed been done, to some extent, from quite a different point of view, by Sir William Ramsay and his coadjutors, in their first investigations on helium; but their observations were directed to finding a practical source of the gas, and were not carried out with anything approaching the minuteness required for the present purpose.

The upshot has been to prove the presence of helium in almost every mineral examined, and even in such unpromising materials as rock crystal, or common quartz sand. The quantity found in the various cases has varied very widely. In fact, minerals may be found having any helium content, from thorianite, which contains 10 cubic centimetres per gram, down to rock crystal, which contains about a ten-millionth part of that quantity.

I have here a small tube of helium obtained from clear, colourless rock crystal, and you will have no difficulty in seeing the characteristic yellow glow as before.

Are we to regard the helium in common minerals as due to a feeble radio-activity of the common elements? No doubt such an hypothesis is tempting, but it must be rejected. Radium is present everywhere in traces, and these traces are in general sufficient to account for the minute quantities of helium. This is illustrated in the table below, which gives in round numbers the actual amount of helium extracted from various minerals by heat, and the amount of helium reckoned relatively to the radium.

	Mineral	Helium present. c.mm. per kil	Helium ratio, *i.e.* ratio of helium to radium. Arbitrary scale.
Normal	Samarskite	1,500,000	14
	Hæmatite	700 .. .	9
	Galena	2	17
	Quartz	2 ...	10
Abnormal	Beryl	33,000	954

There is reason to think, as already mentioned, that the presence of thorium would constitute another source of helium; but it is believed that this complication does not produce any appreciable effect in these cases. You will see that minerals like quartz, though they contain actually only an infinitesimal quantity of either substance, still show about the same proportion of helium to radium as the minerals which are rich in both. We may conclude that helium is connected with radium in the poor minerals as in the rich ones.

I have, however, encountered an interesting exception to this rule in the mineral beryl. Beryl is, in all essentials, the same as emerald; the latter name is kept for stones which are of a clear, deep green colour; but scientifically the distinction is of no importance. Some beryls contain enormously more helium than can be accounted for by the small traces of radium in them. Nor do they contain any appreciable quantity of other radio-active material. What view, then, can we take of the presence of helium in this mineral? It is, to me at least, difficult to believe that the gas can have been introduced from without. If not, can it have been generated from radium formerly existing in the beryl, but now exhausted? This, too, seems unlikely, for it would imply that beryls are older

than other minerals, and there is no plausibility in such a theory from the geological standpoint. My own opinion is that, in all probability, an element hitherto unknown exists in the mineral, from which the helium is generated. It may be objected that, in that case, the mineral ought to be radio-active. If, however, the radiation were emitted with less than the critical velocity, we should not be able to detect it, and nothing is known to make such an hypothesis improbable.

In conclusion, I shall be well content if I have convinced you that there is still something to be learnt from careful examination of the most commonplace materials. If there is nothing new under the sun, there are, at least, unsuspected things going on inside the earth, where the sun cannot penetrate.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—Dr. C. H. Desch, of University College, London, has been appointed university lecturer in metallurgical chemistry in the place of Dr. C. E. Fawsitt, the new professor of chemistry in the University of Sydney, New South Wales.

OXFORD.—Dr. Arthur J. Evans, F.R.S., has handed over as a free gift to the Ashmolean Museum the collection of Anglo-Saxon jewellery and other relics bequeathed to him by his father, the late Sir John Evans. With it is also a comparative series illustrating the early Teutonic art of the Continent, including specimens of Scandinavian, Frankish, Lombard, and Gothic work.

WE learn from *Science* that Colonel Oliver H. Payne, of New York, has given 10,000*l.* to the endowment fund of the University of Virginia.

WE have received a copy of the December issue of *The Record*, the magazine of the South-Western Polytechnic Institute, Chelsea. In addition to items of news about the work and play of students of the institution, the magazine contains short articles from members of the teaching staff and from students.

THE draft charter of incorporation of the University of Bristol has been issued. The following are to be the first chief officers of the new university:—Chancellor, Mr. H. O. Wills; pro-Chancellors, the Bishop of Hereford, the Right Hon. Lewis Fry, and the Right Hon. Henry Hobhouse; Vice-Chancellor, Prof. C. Lloyd Morgan, F.R.S.; and treasurer, Mr. G. A. Wills. Women are to be eligible for any office in the University and for membership of any of its constituent bodies, and all degrees and courses of study in the University are to be open to them. It has been announced that the authorities of the Bristol University College have purchased the blind asylum and its land which adjoin University College. The site thus secured will be used for the erection of part of the new university.

AN appeal is being made on behalf of the Bethnal Green Free Library Institute, which was founded thirty years ago. The institute has no endowment and no State or rate aid, but is entirely maintained by voluntary gifts. There is a lending library, a reading room, and a large reference library. Classes for instruction in various subjects are held, and lectures by Sir Robert Ball, F.R.S., Dr. Andrew Wilson, Dr. W. H. Dallinger, F.R.S., and others, have been provided. The library is entirely free. There is a debt of 250*l.* on the general fund, which the committee is anxious to clear off before the end of the year. Contributions may be sent to the treasurer, Mr. F. A. Bevan, 54 Lombard Street, E.C.

ON Wednesday of last week, December 9, the first annual dinner of old students of the Royal College of Science was held at the Criterion Restaurant, and was attended by more than a hundred old students, in addition to past and present members of the staff and members of the governing body of the Imperial College of Science and Technology, of which the college now forms a part. The chair was taken by Mr. H. G. Wells, who was a student of the college during 1884–7. The toast of the Royal College of Science was proposed by the Right Hon. A. H. D. Acland, who, after making some happy allusions to the descriptions of college life in one of Mr. Wells's books, went on to say that the governing body of the Imperial College intends to do something to foster corporate life among the students by the erection of a suitable building for a students' club. He also made an important statement as to the future of the college, indicating that the governors are fully alive to its great traditions, and that the associateship will still continue to be given as the diploma in science, just as that of the School of Mines is to be the diploma in mining. Mr. A. E. Briscoe, who responded to the toast on behalf of the old students, said that students of the college have gone all over the world, and have had much to do in bringing about that efficient teaching of scientific method which has been so marked a feature of recent educational progress. Many of the old students have made great names for themselves, and he attributed their success to the thoroughness of their training, and especially to the laboratory training they received. He hoped that under the new régime research will be the main work of the college. Subsequent speakers included Dr. H. A. Miers, principal of the University of London, who referred to the imperial character of the work of the college as a valuable feature of modern university life, and Prof. W. P. Wynne, who spoke of the debt owed by many old students to that much-abused body, the Department of Science and Art. At the conclusion of the dinner the old students present proceeded to elect a provisional committee to draw up rules for an old students' association to be submitted to a special meeting at an early date. Mr. T. L. Humberstone, 3 Selwood Place, South Kensington, will act as secretary; all old students who are desirous of becoming members are requested to communicate with him.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 10.—"On the Refraction and Dispersion of Krypton and Xenon, and their Relation to those of Helium and Argon." By C. **Cuthbertson** and M. **Cuthbertson**. Communicated by Prof. F. T. Trouton, F.R.S.

The authors have determined the refraction and dispersion of krypton and xenon with larger quantities of gas than were available at the time of their first isolation. The gases were prepared in the laboratory of Sir W. Ramsay by Prof. R. B. Moore. The atomic refractive index of krypton is found to be

$$\mu = 1 + 0{\cdot}0008378\left(1 + \frac{6{\cdot}97}{\lambda^2 10^{11}}\right),$$

and that of xenon

$$\mu = 1 + 0{\cdot}0013646\left(1 + \frac{10{\cdot}14}{\lambda^2 10^{11}}\right).$$

On comparing these figures with the refractive indices of helium and argon, as determined by W. Burton, it is shown that the refractivities for infinite wave-lengths are even more nearly in the ratios of whole numbers than the earlier values. Taking the value found for argon as the standard, the divergence from integral ratios is, for krypton, 0·0 per cent.; for helium, 0·34 per cent.; and for xenon, 2·25 per cent.

If the refractive indices are expressed by means of Cauchy's formula, $\mu - 1 = a(1 + b/\lambda^2)$, it is found that, plotting a against b for the four gases examined, the relation is linear.

Owing to the untrustworthiness of the existing determinations of the dispersion of oxygen, nitrogen, and hydrogen, comparison cannot be made with other groups of elements.

Physical Society, November 27.—Dr C. Chree, F.R.S., president, in the chair.—A graphic method of dealing with refracting surfaces: H. S. **Allen**. A graphic method is given for finding the cardinal points for combinations of coaxial refracting surfaces. The method may be applied to such cases as that of two thin lenses a finite distance apart, two refracting surfaces forming a thick lens, or to the general case of the combination of two lens systems.

An accurate method of measuring moments of inertia:

the late Prof. W. **Cassie.** In this method use is made of the periods of small oscillations of a balance-beam. The method consists in taking as standard moment of inertia a known mass hung from the knife-edge of a balance and comparing others with it. The time of swing is taken with the standard mass in one pan and a counterpoise in the other. The body the moment of inertia of which is required is attached to the beam in such a manner that the coefficient of the directive couple is unaltered, and the time of swing is determined without weights in the pans. From these times, with a knowledge of the length of the beam and the masses used, the moment of inertia required is easily calculated.—The diffusion of actinium and thorium emanations: S. **Russ.** Experiments were described in which the emanation of actinium was allowed to diffuse into the following gases:—air, hydrogen, carbon dioxide, sulphur dioxide, and argon. The diffusion coefficients of the emanation in these gases agree in general with those calculated by means of Graham's law, making use of the diffusion coefficient in air. The variation with pressure of the diffusion coefficient of the actinium emanation in air was shown to be quite in accordance with the ordinary gas laws, down to a few centimetres pressure, the product of the pressure and diffusion coefficient remaining practically constant. Experiments under identical experimental conditions with thorium emanation over a similar range of pressure also yield nearly a constant value for the product of pressure and diffusion coefficient. The ratio of the two constants thus obtained leads directly to a ratio of the molecular weights of the two emanations, the result being that thorium emanation appears to have about 1·4 times the molecular weight of actinium emanation.—The elliptic polarisation produced by the direct transmission of a plane polarised stream through a plate of quartz, cut in the direction oblique to the optic axis, with a method of determining the error of a plate supposed to be perpendicular to the axis: J. **Walker.**—An experimental investigation of Gibbs's theory of surface-concentration regarded as the basis of adsorption: W. C. M. **Lewis.**

Geological Society, December 2.—Prof. W. J. Sollas, F.R.S., president, in the chair.—The geological interpretation of the earth-movements associated with the Californian earthquake of April 18, 1906: R. D. **Oldham.** At the time of the San Francisco earthquake movement took place along a fault, known as the San Andreas fault, which can be traced for a distance of about 200 miles. A re-measurement of the primary triangulation in the region shaken by the earthquake revealed considerable displacements, increasing in amount as the fault is neared, and of such nature that places to the east of the fault were shifted southwards, while those to the west of it were shifted northwards. The extent and peculiar distribution of these displacements negative the supposition that the fault was the cause—it must rather be regarded as a consequence of, or an incident in, the earthquake, this word being used to denote the disturbance in its entirety. The author considers that the displacements cannot be explained in a satisfactory manner on the supposition that they are the result of strains affecting the crust of the earth as a whole, but may be explained by the difference in character and behaviour of the materials composing the greater part of it, where pressures are great enough to produce the phenomena of solid flow, and of those in the outer skin, where the pressures are not great enough to produce any material difference in the behaviour of rocks from that which we associate with solidity, as experienced at the surface of the earth. The surface-displacements constituting the earthquake, as ordinarily understood, arise from disturbances in the outer skin; but in great earthquakes, like the one dealt with in the paper, these may be the result of more deep-seated disturbances affecting the whole crust of the earth.

Linnean Society, December 3.—Dr. D. H. Scott, F.R.S., president, in the chair.—Biscayan plankton: a memoir on the Ostracoda captured during the 1900 cruise of H.M.S. *Research*: Dr. G. Herbert **Fowler.** More than 7000 specimens had been identified, and in the case of more than 3000 the sex had been determined and the lengths of the shells measured. As the result of these measurements, the writer was enabled to formulate provisionally a new law of growth in Crustacea:—"During early growth each stage increases at each moult by a percentage of its length, which is constant for the species and sex." For this the name of Brooks's law was suggested, Prof. W. K. Brooks having made the first observations which led to it; it had been checked to some extent by observations on lobsters (Herrick) and crabs (Waddington).—Mimicry in spiders: R. Innes **Pocock.**—Note on *Juniperus taxifolia*, Hook. and Arn.: Bunzō **Hayata.** This species had been described from specimens from the Bonin Islands, but had also been recorded from the province of Hupeh, China; further examination shows that the Chinese plant is specifically distinct from that occurring in the Bonin Islands.

Mathematical Society, December 10.—Sir W. D. Niven, president, in the chair.—The theory of waves propagated vertically in the atmosphere: Prof. H. **Lamb.** Two cases are considered. In one the undisturbed atmosphere is taken to be at a uniform temperature. In the second the temperature gradient is taken to be uniform, the temperature diminishing upwards. In both, the variations of pressure and density involved in the propagation of the waves are taken to follow the adiabatic law. Even when viscosity is taken into account, it appears that the amplitude of the waves, due to arbitrary initial disturbances, tends to increase indefinitely as the waves travel upwards. One unexpected result is that an unlimited atmosphere may possess a definite natural period of vibration in the sense that an impressed local periodic force, of this, but of no other, period, would generate an oscillation of continuously increasing amplitude.—The representation of a function by series of Bessel's functions: Dr. E. W. **Hobson.** The question considered is that of the convergence of a series of the kind that arises in the problem of the vibrations of a membrane or the two-dimensional vibrations of gas in a circular cylinder. It is shown that the series converges and its sum represents the function which it is meant to represent, in the same way as Fourier's series represents a function, provided that the function is integrable according to Lebesgue's extended definition, and that if the function is infinite at the origin, the infinity is not of too high an order. The order in question must be less than —Theory of Cauchy's principal values (fourth paper): G. H. **Hardy.** The paper deals with the possibility of interchanging the order of integrations in repeated infinite integrals which have finite principal values. A number of results bearing on the problem of the inversion of a definite integral are obtained.—Differentials: Dr. W. H. **Young.** It is shown that in the case of any number of variables the differentials take precisely the place in expansion theorems which are occupied by the successive differential coefficients in the case of functions of one variable.—The solution of the homogeneous linear difference equation of the second order: G. N. **Watson.** The problem is that of determining a function of the complex variable x which satisfies the equation

$$A(x)f(x+1)-B(x)f(x)+C(x)f(x-1)=0,$$

wherein $A(x)$, $B(x)$, $C(x)$ are known uniform functions. It is shown that the required function can be determined provided the functions A, B, C satisfy restrictive conditions which are satisfied by wide classes of functions.—Four systems of three quaternary quadrics that can be expressed by means of five squares: Prof. A. C. **Dixon.**—(1) The reduction of a quaternary cubic from the sum of six cubes to the sum of five; (2) addition to a paper on the eliminant of three quantics in two independent variables: A. L. **Dixon.**—Note on a continued fraction equivalent to the remainder after n terms of Taylor's series: Prof. L. J. **Rogers.** Solid angles and potentials of plane discs: **Balak Ram.**—A method of solving the problem of Mersenne's numbers: Dr. T. **Stuart.**

EDINBURGH.

Royal Society, November 16.—Dr. Burgess, vice-president, in the chair.—An investigation of the seiches of Loch Earn by the Scottish Lake Survey, parts iii.–v.: Prof. **Chrystal.** The part of this memoir communicated bore specially upon the endeavour, by critical examination of seiche records, chiefly on Loch Earn, to come to some definite conclusion as to the origin of the seiche.

Seven different causes might be assigned, namely, progression of the isobars, wind denivellation, rapid flooding, partial rainfall, squalls, impact of wind gusts, and periodic minor fluctuations of the atmospheric pressure. Lantern-slides were shown giving simultaneous microbarograms, anemograms, and limnograms taken on Loch Earn, and from these it appeared that the most frequent causes of seiches were squalls and periodic minor fluctuations of atmospheric pressure. The well-known embroideries which appear on limnograms during windy or unsettled weather were found to be due, in many cases, to solitary waves or groups of waves which are raised by small squalls. In some cases these wave-groups travel faster than the squall which produces them, so that the lake vibration at certain places precedes the wind disturbance which has caused it but is following after it. A particularly good instance was observed of an atmospheric-pressure fluctuation which was steadily periodic for several complete periods, and which was immediately responded to by a seiche of marked periodicity. An account of the mathematical theory was reserved for the next meeting.—Notes on hydrodynamics, chiefly on vortex motion: Prof. Andrew **Gray**. These depended upon a novel transformation of the usual hydrodynamical equations, leading to specially neat forms of solution of certain types of problem.

December 7.—Dr. Horne, F.R.S., vice-president, in the chair.—A monograph on the general morphology of the myxinoid fishes, based on a study of Myxine, part iii.: Prof. F. J. **Cole**. The chief interest of this continuation of previous papers on the same subject lay in the illustrations, which had been carefully and elaborately drawn.—An investigation of the seiches of Loch Earn by the Scottish Lake Survey, parts iii.–v.: Prof. **Chrystal**. The memoir concluded with a mathematical appendix on the effect of pressure disturbances upon the seiches in a uniform parabolic lake. Rayleigh's method of normal coordinates was made use of with great advantage. The first problem solved was the effect of a uniform excess of pressure over a part of a lake, the excess being assumed to last for a definite time, usually the half-period of one of the seiches, the uninodal, binodal, or trinodal, as the case might be. The amplitudes of the seiches generated were calculated, and found to be of the same order of quantity as the pressure disturbance when estimated in terms of the water barometer. The disturbance caused by a suddenly generated distribution of pressure, expressible in a series of zonal harmonics, was then found, and this led, by use of the principle of superposition, to the calculation of the effect of a pressure disturbance varying both in space and time. The special case of a sudden rise of pressure, propagated with uniform velocity from one end of the lake to the other, was worked out in detail for a lake of parabolic bottom contour six miles long and 270 feet in depth. It was proved that the uninodal seiche was most affected when the disturbance was propagated with a speed of thirty-seven miles per hour.

MANCHESTER.

Literary and Philosophical Society, December 1.—Prof. H. B. Dixon, F.R.S., president, in the chair.—The dawn of human intention: an experimental and comparative study of eoliths: Prof. A. **Schwartz** and Sir Hugh R. **Beevor**. The term "eolith" was first used to designate certain flint chippings found by Mr. Benjamin Harrison in the chalk plateau in Kent, which bore traces that led him to suggest that they were really primitive tools of early man. This view, though receiving the support of De Barri Crawshay and Prestwich, was not generally accepted, and evoked much controversy. The authors now sought to show that the existence of eoliths as the work of man was a fact which was capable of demonstration. They found from anatomical and mechanical considerations that the fundamental processes in which primitive man would need the aid of tools were:—(1) striking; (2) cutting; (3) scraping; (4) piercing; and (5) the production of fire. Then, selecting suitable fragments of flint, they performed with them the simple operations involved in these processes, carefully noting the effects of such use, and of the secondary work of re-sharpening, on the flints themselves. In this way they were able to establish certain definite characters for each hypothetical class of tools. A comparison of eoliths, collected in considerable numbers from different sources, with the artificially produced tools showed a very close agreement in respect of their characters.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 17.

LINNEAN SOCIETY, at 8.—The Anomura of the Red Sea: W. Riddell.—Forms of Flowers in *Valeriana dioica*: R. P. Gregory.—Études sur les Cirrhipèdes du Cambridge Museum: Prof. A. Gruvel.—Rhynchota from the *Sealark* Expedition: W. L. Distant.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Electric Discharge and the Production of Nitric Acid: W. Cramp and B. Hoyle.

INSTITUTION OF MINING AND METALLURGY, at 8.—A Visit to the Mineral Districts of Canada: W. Frecheville and H. F. Marriott.—Notes on Plant in the Mining Districts of Canada: R. E. Commans.

FRIDAY, DECEMBER 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Type-casting and Composing Machinery: L. A. Legros.

INSTITUTION OF CIVIL ENGINEERS, at 8.—High-power Water-turbines on Moderate Falls: R. Wolfenden.

MONDAY, DECEMBER 21.

FARADAY SOCIETY, at 8.—The Influence of Cheap Electricity on Electrolytic and Electrothermal Industries: E. A. Ashcroft.

TUESDAY, DECEMBER 22.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Investigation of the Heat-losses in an Electric Power-station: F. H. Corson.

CONTENTS.

THURSDAY, DECEMBER 24, 1908.

THE ANATOMY OF DICOTYLEDONS.

Systematic Anatomy of Dicotyledons: a Handbook for Laboratories of Pure and Applied Botany. By Dr. H. Solereder. Translated by L. A. Boodle and Dr. F. E. Fritsch. Revised by Dr. D. H. Scott. Vol. I., Introduction, Polypetalæ, Gamopetalæ. Pp. xii+644. Price 24*s.* net. Vol. II., Monochlamydeæ, Addenda, Concluding Remarks. Pp. vi+645 to 1182. (Oxford: The Clarendon Press, 1908.) Price 24*s.* net.

THE long-expected translation of Dr. Hans Solereder's "Systematische Anatomie der Dicotyledon," which has recently been issued by the Clarendon Press, is the latest addition to the splendid series of English translations of classical German works for which all English-speaking people owe a deep debt of gratitude to the Oxford Press.

Except for the introduction and for the "concluding remarks," which appear at the end of the second volume, Dr. Solereder's work cannot be recommended for a course of continuous reading. As a work of reference, however, and as an exhaustive guide to the literature of the anatomy of Dicotyledons, the book will be found to be invaluable. Under each natural order the vast amount of material to be dealt with is arranged according to a common plan; a review of the anatomical features is first given, this is then followed by an account of the structure of the leaf, the subject being subdivided under the epidermis, stomata, internal structure, crystals, hairs, glands, and the structure of the petiole. The structure of the axis forms the third division, which is subdivided according to the peculiar needs of each natural order. Some account is also given of any anomalous or remarkable structures, and finally a complete list of the literature, brought, so far as possible, up to date, is placed at the end of each order.

One hundred and fifty-three figures in the first volume and thirty-six in the second are scattered through the text to illustrate typical or peculiar anatomical features in the various orders or genera. It would clearly be impossible to attempt to review or to criticise in detail the vast mass of material which has been compressed into the pages of these volumes, for the value of the book can only become apparent to anyone actually working in the laboratory at the comparative anatomy of a natural order or a group of genera.

Dr. Solereder's work will occupy much the same position as a work of reference for the morphological botanist as the "Index Kewensis" does for the pure systematist. One looks through its pages in the hope of finding that some light may be shed on complicated taxonomic problems, only to be disappointed. Dr. Solereder's book, however, serves as the key by which the door may be opened by both the plant anatomist and taxonomist to a common field of fruitful investigation. It is somewhat remarkable to notice the extent to which anatomical research tends to confirm the conclusions of the systematist, as, for instance, in the Loganiaceæ; all the genera of the Loganioideæ are found to have bicollateral vascular bundles, whilst all the Buddleioideæ have simple collateral bundles. Further, in the allied order Gentianaceæ, bicollateral bundles are characteristic of practically all the representatives with the exception of the Menyantheæ. As to the affinities of some of the orders, the position of which is uncertain, as, for instance, the Coriariaceæ, little further light, unfortunately, is shed by the anatomical method. On the other hand, the method may be of great service in the case of assigning a peculiar genus to its proper position in the natural system. The genus Chalepoa, for example, which had been placed with the Pittosporeæ, has been transferred to the Saxifragaceæ, owing to the absence of the resin canals characteristic of Pittosporeæ.

A yet more interesting case of the service which can be rendered to systematic work by the anatomical method was afforded some years ago by Radlkofer (British Association Report, Aberdeen, 1885), when he was attempting to determine some of the fragmentary material in old herbaria. From an examination of *Sideroxylon mite*, L., in the Linnæan herbarium, it was found that this plant did not belong to the Myrsineaceæ, as suggested by Sprengel, who named it *Myrsine mitis*, Spreng., but was in reality a specimen of *Ilex capensis*, Sond. Another supposed species of Myrsine, *M. marginata*, Hook. et Arn., was found, from the examination of a fragment of the plant, to belong to the Sapotaceæ, and to be a specimen of *Chrysophyllum marginatum*. Unfortunately, Solereder has misquoted these facts in his book (p. 508, footnote 1), and refers *M. mitis* to the Sapotaceæ and *M. marginata* to the Ilicineæ.

In the second volume the Monochlamydeæ occupy the first 158 pages; these are followed by 264 pages of addenda to the various natural orders, and the remainder of the volume is occupied by the concluding remarks (98 pages), a literature supplement embodying the latest papers, a brief index, and a glossary. It is of interest to notice, among other points, that on anatomical evidence the natural order Basellaceæ established by Moquin-Tandon is maintained as a distinct order from the Chenopodiaceæ.

In the concluding remarks the various characters which may be used in the anatomical method are passed in review under seven headings or chapters, and this summary is intended to serve as an aid in the determination of a plant by means of its anatomical characters. The seven subdivisions are:—(1) Structure of the lamina of the leaf; (2) structure of the petiole; (3) secretory and excretory receptacles; (4) hairy covering; (5) normal structure of the axis; (6) anomalous structure of the axis; (7) structure of the root. The treatment of the subject in these chapters is of a very exhaustive nature, and, so far as can be seen, every structure of importance in any part of the plant is carefully and systematically dealt with.

Dr. Solereder makes an earnest appeal to systematists to make use of the anatomical method so far as possible when publishing new genera and new species. In time, no doubt, this will be done, but at present the amount of material requiring careful and critical examination in our herbaria is so great, and

the work involved in the systematic adoption of the anatomical method is so enormous, that it seems hardly likely that great progress will be made in this direction for some time to come.

The value of chemical substances in the plant is also emphasised for helping to establish points of affinity, though cases do occur in which similar substances of a peculiar nature are found in quite unrelated plants. One of the difficulties of the method lies in making the choice of those anatomical characters which may prove to be of systematic importance. It is clear that characters, which are ancestral rather than adaptive, will be of most value from the taxonomic point of view. The value of an anatomical character, however, cannot be predicted, and at times exceptions will be found to a character which appears to be otherwise typical of the particular group or order. Much light may be expected to be thrown by the anatomical method as to whether certain features in a plant are to be regarded as ancestral or adaptive from a comparison with other closely allied plants; and it may be noted in passing that careful work in this direction is being done on the anatomy of seedlings in this country. A word of warning, however, is necessary, which is not forgotten by the author, to those adopting the method, since it is not yet known whether a given character may be constant in a single species under different conditions of cultivation. The tea-plant, for instance, may or may not possess spicular cells in the leaf.

Dr. Solereder concludes his excellent and interesting introduction with a summing up of the possibilities of and warnings against the dangers of the anatomical method. It only remains to praise most highly the way in which Messrs. Boodle and Fritsch, under the careful editorship of Dr. Scott, have carried out the very arduous work of translating a volume, every page of which seems scarcely large enough to contain the solid and pregnant matter with with it is crowded.

A word of thanks must be added to Dr. Fritsch for the glossary at the end of the second volume, in which the chief terms used in anatomical description are defined, or a reference to a definite passage in the work is given where such terms are explained. In most cases the German equivalents of the terms are given, making the glossary of considerable value.

A. W. H.

PROBLEMS OF THE PAPER MILL.

Chapters on Paper-making. Vol. v., Concerning the Theory and Practice of Beating. By Clayton Beadle. Pp. vii+182. (London: Crosby Lockwood and Son, 1908.)

THIS is a record of observations incidental to an analytical study of the process of "beating" in the paper mills, the process by which the fibrous raw materials are prepared, by wet milling, for the actual paper-making operations. The central importance of the beating process is generally recognised; it is also evident that it is a highly complex operation. The purpose of this volume is to suggest to paper-makers what are the factors of the result, and how they may be effectually studied by way of observations which can be recorded in terms of numbers.

The author's observations are in the main those of mechanical energy consumed in the various stages of beating, *i.e.* in the "breaking in," the "beating" proper, and in "refining."

Beaters of the various types have been analytically studied, and the results are discussed in reference to the general structural details of the machines themselves, as well as of the main working parts, that is, the roll and the bed-plate. The main purpose is to establish their relative economy and efficiency. Thus the Hollander is generally contrasted with the more modern types of beaters, *e.g.* the "Reed," the "Taylor," and the "Tait engine," and the separated operations of "refining" in such engines as the "Kingsland" or "Jordan." Chapter x., on "the relative merits of stone and metal beater bars," is a useful contribution to progressive problems.

The author generally avoids drawing positive conclusions in view of the fact that efficiency, or the integral result of the preparation, involves those still obscure factors of condition, that is, the relation determined between the beaten fibres and the watery medium in which they are carried in suspension, to be compacted into the wet web on the wire of the paper machine or mould. This is the subject-matter of a special chapter (chapter xvii.), which records the results of experiments in the grading or fractionation of pulps by dry or wet methods, the former giving results according to dimensions, the latter introducing the complicating factor of "hydration" or "wetness."

The book is certainly a record of progress in the technology of paper-making. It emphasises the criticism which paper-makers make on the realistic tendencies of our technical schools. A "model" paper-making plant, such as has been installed at the Manchester School of Technology, is so far illusive in its realism that a "model beater" is not a representation to scale of the working conditions of the ordinary engine; and as the beating process constitutes the essential preparation of pulps, the educational result of a model mill is weakened by the implication of an incorrect perspective.

Contrariwise, the author's observations suggest an individuality or idiosyncracy of beating engines, and this degree of unconformity to type entails special study of each machine in work, which study may be purely empirical or may be based upon selective quantitative investigations of the essential factors.

The technical records of this book are intended to serve as models of such investigations in the mill.

The educational value of this volume is weakened by its method or want of method. The author trusts his matter to evolve its own logical form and cohesion, wherein he so far abdicates the privileged position of teacher, which is to be didactic even when some risks have to be taken in stating conclusions; this is necessary to awaken and sustain the interest of the student.

The matter would be much improved by a clear *exposé* of principles, and the contributory factors of

aggregate effects, the experimental results being used to illustrate and develop the argument.

These criticisms do not depreciate the value of the volume as a record of serious, useful experimental inquiry. It is expressly to be commended to managers and workers in the mill, who will find in it much to stimulate observation and investigation with immediately productive results.

THE WORKS OF LINNAEUS.

Linnaeus. Door Dr. J. Valckenier Suringar. Pp. 106. (s'Gravenhage: Martinus Nijhoff, 1908.)

THE scope of this volume may best be given by a summary of the introduction. The author says that though much has been written about Linnæus, yet he is but imperfectly known, which is probably due to the fact that the various accounts and addresses only supply a very superficial picture of the man. His sexual system and binomial nomenclature are the warp and woof of his work, and many who are content to regard Linnæus as a great man are ready to ask if these two achievements are anything out of the common. With the exception of a few volumes of systematic descriptions, Linnæus's books are no longer read, for who in these days of rapid work can find sufficient time to read his Latin octavos?

With a view to remedy this state of things, the author proceeded to study the works of Linnæus, and the farther he went the more his wonder grew. From the very first, Linnæus was evidently a giant amongst his contemporaries, and from him a stream of science has flowed and has overpassed its boundaries, leading with titanic force into new paths. Linnæus's work may be taken as an example for all time of methodic application and achievement. The year of the festival (1907, when the preface was written) may be taken as a fitting opportunity to set out the result of the inquiries in honour of Linnæus.

Very little will be found in this volume of biographic detail which may readily be found elsewhere. The author's aim has been to display the man and his ideals, so far as practicable, in his own words. In addition to this, the contemporaries and correspondents of Linnæus have been drawn upon, especially two men of renowned personality, Dillenius and Haller, the latter at once friend and opponent, and so giving a truer notion than by any other means.

The author has thus produced a work which in many respects stands alone. Deliberately refusing to supply biographic details or speculations, it differs markedly from the admirable volumes of Prof. Fries and the unfinished fragment of the late Prof. Oscar Levertin. Dr. Suringar follows Linnæus in his publications from early years to maturity. He has scrutinised the text and any published letters which bear upon them, and has thus succeeded in setting before us the man and his aims, his astonishing powers of work, his poetic imagination, his magnetic attraction, his artless vanity, his real modesty—the modesty of a great worker who has higher aims than those attained. Full references are given to the illustrative passages, both in original and in translation.

Dr. Suringar dwells at some length upon four ideas promulgated by Linnæus in his "Systema Naturæ" and the "Genera Plantarum" which soon followed it. These four are:—(1) A clear generic idea, (2) natural description of genera, (3) the sexual system, and (4) generic nomenclature. In each one of these, Linnæus so immensely improved upon the notions of his predecessors that his improvements became predominant almost of necessity. Each of these is separately considered and their relative merits weighed.

We must confess that we should have been grateful if the author could have thrown more light upon the life of Linnæus during those three busy years he spent in the Netherlands. The record is marvellous, even bearing in mind that Linnæus brought several manuscripts with him, but the cares of proof-reading must have been great. Clifford, though liberal, was keen upon securing full value for his outlay, and the splendid "Hortus Cliffortianus" was entirely composed and printed whilst Linnæus was under Clifford's roof. He confessed in a letter that he was too busy to eat, and still more so to sleep. Small wonder that three such strenuous years should have broken down the strong constitution of the young Swede, and made his longing for home irresistible. Possibly his life was too devoted to natural history to have any noteworthy events.

No one can read the volume without gaining a better idea of the strong personality and genius of the Småland curate's son, who, by his genius and powers of work, transformed the whole conception of biology, and established it on a basis and with a nomenclature which permitted of its development according to modern needs. Everybody who was present last year at the Linnean celebrations in Sweden must have been struck by the deep hold Linnæus has upon the hearts of his fellow-countrymen. Dr. Suringar has brought together passages from various sources which go very far to justify the pride of the Swedes in their great naturalist.

B. D. J.

PRACTICAL PHYSICS.

A Manual of Practical Physics for Students of Science and Engineering. Vol. i., Fundamental Measurements of the Properties of Matter and Heat. By E. S. Ferry and A. T. Jones. Pp. xi+273. (London: Longmans, Green and Co., 1908.)

THIS volume is a very sound introduction to the practical measurement of the properties of matter and the more important properties of heat. The book is strictly practical, no attempt being made to discuss theories; sufficient explanation is, however, usually given for a clear and intelligent appreciation of the succeeding experiment.

The book commences with a consideration of the value of errors, the principles of which are not afterwards given due importance. The section then ends with a somewhat elementary introduction to the

graphical expression and reduction of results, and a number of algebraical summations for the later application of calculus from first principles.

The measurement of distance, mass, and time calls for little remark. The apparatus described is not novel, but is fairly complete, comprising as it does all the common instruments of precision and the precautions necessary for correct use. Here particularly the absence of theoretical considerations is noticed, the derivations of the units not receiving notice, *e.g.* no definition of the second is given.

The third chapter deals with measurements of small quantities by means of the optical lever, a rather uncommon experiment on a spirit-level, and a very good treatment by simple algebra of Amsler's planimeter.

Then follows a very limited introduction to velocity and acceleration, the only acceleration determined being *g* by the usual pendulum observations. Specific gravities and the calibration of weights are treated exhaustively.

The chapters on moment of inertia and elasticity are somewhat difficult, as the explanations are complex algebraically. The experiment on moment of inertia by torsional oscillations is sound, but the experiment for Young's modulus is open to serious error due to slipping in the grips at both ends. The definition of "brittleness" is misleading; those of flexure and rigidity are difficult but correct.

The chapter on viscosity includes a good description of Poiseulle's capillary-tube experiment.

The measurement of temperature is, on the whole, accurately and completely given. The statement that gas thermometers can be used up to 1700° C. is not, however, correct so far as accuracy is concerned. Again, for the resistance thermometers difficulty of experiment has led the authors to evade the sulphur point and to minimise its importance. Mercury-in-glass thermometers are fully treated.

The experiments on the expansion of rods are open to the objection that the temperature must be indeterminate near the ends. The absolute expansion of mercury and the cubical expansion of glass are given more successfully.

The difficult subject of calorimetry receives considerable attention and is sound. The method of mixtures, the bomb calorimeter, and the Junker calorimeter are described fully as pieces of apparatus most suitable for their respective purposes.

An extremely short chapter gives an introduction to the principle of the conservation of energy, and the book concludes with some useful tables of physical constants.

L. B.

THE EDIBLE CRAB.

L.M.B.C. Memoirs. XVI. Cancer. By J. Pearson. Pp. xviii+209. (London: Williams and Norgate, 1908.) Price 6*s.* 6*d.*

IT is a remarkable thing, perhaps, that although the edible crab is of so much importance as an article of food, and is also an easily obtained subject for the study of the morphology of the brachyurous Crustacea, this is the first concise statement of its structure and habits that has been published in any language.

It might have been advisable if the editor of the series had departed from his usual practice and allowed in this case the use of a short subtitle to the memoir, such as "the edible crab," since the books that have been published upon "Cancer" in recent years are without number, whereas this is the only one on the crab.

The need of a memoir on the subject has long been felt, as the records of investigation are scattered and somewhat difficult of access; but Mr. Pearson has evidently devoted very great care and patience to the collection of all the available information, and, having added to it a great deal that is new, he has produced a work which will certainly prove to be one of very great utility.

The author has a liberal conception of what is necessary in a memoir concerning a single species, and he gives not only a detailed description of the external features and general anatomy, but also some important and useful notes on the histology and physiology. There are two surprising facts about Cancer which may be learned from this memoir. The one is that we know very little about the larval development of an animal that is so common and so useful, and absolutely nothing about its pre-larval stages. It may be that the early development follows a course that we might expect from our knowledge of these stages in other crabs; it may be that the study of these stages would not produce any facts of practical importance; but it is an object-lesson on unexplored fields of marine biological investigation that we have to confess to such ignorance about a familiar type. The second surprising fact, but not a new one to those who study fishery statistics, is that the value of the annual catch of crabs on the coasts of England and Wales alone is nearly 60,000*l.* But notwithstanding this fact we are indebted to the energy of Prof. Herdman and his colleagues for the greater part of the necessary funds for the production of a memoir which must prove to be of great economic value.

For the advanced student of zoology the memoir will undoubtedly prove of the greatest assistance when he comes to the dissection of the crab, and he will learn to appreciate the concise and, so far as we have been able to test them, accurate statements of anatomical facts and the thirteen beautiful plates by which the memoir is illustrated. It would have been better if the descriptions of the figures had been in many cases extended, so that the reader could see at a glance the principal points that each figure is intended to illustrate. When there are so many plates, and no less than six full pages of reference letters arranged in alphabetical order, the system adopted becomes rather tiresome to the reader. It would also have been useful to the student if Mr. Pearson had given a short statement concerning the other common crabs of the coast for which Cancer might be mistaken and the principal features which distinguish them. But the memoir may be heartily welcomed as it is, and Prof. Herdman and Mr. Pearson congratulated on its publication.

THE ASHMOLEAN NATURAL HISTORY SOCIETY OF OXFORDSHIRE.

A *Historical Account of the Ashmolean Natural History Society of Oxfordshire*, 1880–1905. By Frank Arthur Bellamy. Pp. xvi+544. (Oxford: Published by the Author, 4 St. John's Road, 1908.) Price 10*s*. net.

THE volume before us should have an interest, not only for members of the society in question, but for all naturalists, who should be glad to possess a record of the doings of one of the largest, most active, and—in virtue of its amalgamation with the Ashmolean Society, founded in 1828—one of the oldest scientific societies in England. It is seldom that such an organisation finds so good a biographer; the precision of the astronomer can be traced in the author's attention to the minutest details of history, and the care taken to ensure accuracy with regard to every point mentioned. Owing to the arrangement adopted, it has evidently been impossible to avoid the slight overlapping of subject-matter, but there can be few if any questions relating to the society's existence and work which are not dealt with in this very comprehensive record.

It is probably true of almost all societies that they owe much to their officers, but especially has this been true of the Ashmolean Natural History Society of Oxfordshire in all stages of its chequered existence. Of the earliest officers of the "old Ashmolean" little is known, owing to the disappearance of the original minute-books; the "Proceedings" of that society were not published until some years after its origin, though we learn (p. xv) from the Radcliffe Observer in 1866 that

"At the time of its institution it was second to scarcely any similar society in Europe, either in the roll of its illustrious members or in the value of its contributions to science."

So late as 1880, however, it had not opened its doors to any but members of the university, and this fact gave origin to the Oxfordshire Natural History Society and Field Club, founded by the even then well-known botanist Mr. George Claridge Druce, with the cooperation of many distinguished men of science.

No circumstance is more happy in the history of the two societies than that when the "old Ashmolean" decided to unite the property and traditions of a glorious past and—shall we say?—a somewhat decadent present to the active existence and brilliant future of the society which now holds a well-deserved position as the senior scientific society of Oxford. The tale of how this was accomplished is fully set forth in Mr. Bellamy's pages, as well as the part played by many of the society's officers in bringing about this union. Perhaps a large share of honour may be felt to be due from English naturalists generally to Dr. V. H. Veley, F.R.S., whose strenuous exertions as last librarian of the older society alone saved from an ignoble fate and made available for all time one of the largest and most valuable *lending* scientific libraries in England, which included complete sets of periodicals no longer obtainable at any price, as well as single volumes of great rarity.

Mr. Bellamy's history shows that no "winter wind" of ingratitude ever blew over the Ashmolean Natural History Society, for are not all these things, as well as the labour of love of many presidents, treasurers, librarians, and secretaries, writ large in his chronicle? The only person whose unremitting if unobtrusive labours on behalf of the society receive a bare line of notice is the author himself (p. 121). But none who knows the inner history of the society will fail to give honour where honour is due. Such a record must necessarily contain many dry facts and statistics, which are of value mainly to those concerned, but there is ample evidence that such researches may be enlivened by flashes of humour, as in the account of the recovery of the ancient woodblock (p. 59) and of other quaint occurrences.

The book is excellently printed, and contains as frontispiece a portrait of the late Prof. J. O. Westwood.

L. J. V.

ELECTROCHEMICAL PRACTICE AND POWER DEVELOPMENT.

(1) *Cyanide Processes*. By E. B. Wilson. Fourth edition. Revised and enlarged. Pp. vii+249. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 6*s*. 6*d*. net.

(2) *Electric Furnaces. The Production of Heat from Electrical Energy and the Construction of Electric Furnaces*. By Wilhelm Borchers. English Translation by H. G. Solomon. Pp. ix+224. (London: Longmans, Green and Co., 1908.) Price 7*s*. 6*d*. net.

(3) *Hydro-electric Practice. A Practical Manual of the Development of Water Power, its Conversion to Electric Energy, and its Distant Transmission*. By H. A. E. C. von Schon. Pp. xv+382. (Philadelphia and London: J. B. Lippincott Company, 1908.) Price 25*s*. net.

(1) THIS book upon "Cyanide Processes for Gold Extraction" is evidently intended for those who know nothing about the extraction of gold by means of cyanide, and it is therefore written in a style to suit the tyro, and is also intended to help those who wish to take up the cyanide-extracting industry. It commences with a description of ores suitable for the cyanide process, and starts off with the definition that any material which it will pay to work is an ore. Ores are distinguished as free, milly, refractory, acid, and base-metal ores, and it is shown how these various ores behave towards cyanide solutions. We notice on p. 11 that tellurium is said to be soluble in the presence of sodium dioxide, but sodium dioxide is hardly a substance which one expects to find employed in the extraction of gold.

We regret to say that chapter ii. is very unsatisfactory. It deals with potassium cyanide and oxygen, and contains several equations, some of which are not correct; but chapter iii. is still worse, and this has to do with the chemistry of the operation. On p. 27 we notice that there are men working the cyanide process successfully who know little of its chemistry and no other chemistry at all. From this chapter they will not learn correct chemistry of the cyanide

processes, and they certainly will not learn other chemistry.

The author seems to be unaware of the elementary principle that both sides of an equation must balance; in one case, for example, where there is only one potassium on the left-hand side of the equation he has potassium carbonate upon the other side. He gets over the difficulty of lack of potassium by writing potassium carbonate KCO_3. We may also point out that ferrous sulphate is not Fe_2SO_4; one would have thought that he might have found a more recent equation for the action of ferrous sulphate than that of Berzelius. The chapter on laboratory tests is better, but until we get to chapter v. ("The Plant for Cyaniding") the author is out of his depth. It is evident, however, that he does understand the practice of the cyanide process.

It is interesting to note how, as the subject of "leaching" has become better known, and the methods of treatment of the ore more carefully worked out, so the strength of the cyanide solution employed has gradually become weaker and weaker, and the extraction of gold, more through loss of cyanide during the operation, has become less. When the author comes to dealing with electrocyaniding, that is to say, the recovery of gold by electrical means, we wish he had asked someone else who understood the subject to write this part for him. He has collected many facts jumbled up in a manner which would spell absolute confusion to anyone not versed with electrochemical methods For example, speaking of anodes, and referring to platinum, he first of all says that the decomposition which takes place of the electrolyte at the anode is energy expended, not on work, but in setting free oxygen which will probably decompose the electrolyte; and then he goes on to write about the amount of platinum which should be liberated in an ampere-hour, but we do not profess to know what he means. The extraordinary thing is that all these mistakes of nomenclature and misprints occur in a book which is in its fourth edition. The practical part of the book with reference to leaching of the ores and so on can be recommended as being useful; we prefer not to say anything about the rest of it.

(2) The second book is of an entirely different class, and is written in quite a different style. Any book by Prof. W. Borchers upon electric furnaces is sure to attract interest. We notice, however—but it is perhaps not to be wondered at—that the furnaces designed by Prof. Borchers himself loom rather large. He certainly has done much pioneering work, and has had some extremely good ideas, but it is to be feared that others gained by his suggestions more than he himself.

The book commences with an introduction in which the conversion of electrical energy into heat is discussed. Each chapter of the book deals with a different class of furnace, and in every case the subject is treated in a more or less historical manner. Chapter ii. is devoted to direct-resistance heating, and deals in the first place with the production of aluminium, and we notice on p. 23, in reference to the Héroult furnace, a mistake in which the word "anode" twice occurs instead of "cathode." The chapter also has an account of the various induction furnaces, the description of which is all too short; this is such an important branch of electrometallurgy that it would have been well worth while to have given a much fuller and more descriptive account of it.

Chapter iii. deals with indirect resistance furnaces, in which the substance to be heated is in contact with another material, which is electrically heated; this may be a core running through the furnace, which, by means of its resistance, becomes highly heated. The substance which it is required to heat or reduce is placed round about it, and thus receives the heat from the core. Mention is also made of the kryptol furnace. Direct arc heating is the subject of the next chapter, and here the author deals with carbide furnaces, and refers to the acetylene arc furnace of Berthelot. The phosphorus arc furnace of Readman and Parker is also described. Indirect arc heating is the subject of the next chapter, such, for example, as is employed in zinc furnaces for the distillation of the metal.

The last two chapters are devoted respectively to the arrangement of furnaces for different modes of heating, and to the construction of electric furnaces in general. A short appendix by the translator is devoted to some recent developments in electric steel furnaces.

The book is decidedly useful, is very well illustrated, and carefully translated, but at times the description is scrappy, and we are rather afraid the reader who knows nothing about furnaces will hardly get sufficient information to be of service.

(3) The third book deals with hydro-electric practice, and is an extremely valuable contribution to the subject. The author has written it for two classes of readers. The first part is intended for those who have no engineering training or experience—that is to say, for the layman who may desire to know something about water-power schemes, and to whom it is necessary to have some idea as to whether it would be advisable to risk anything in the undertaking or not. The second part, entitled "Designing and Equipping the Plant," is written for the student, and the aim of the author has been to make the treatment of this part of the subject complete in all its phases, with the exception that he presupposes a knowledge of the principles of surveying and of the rudiments of hydraulics, hydrostatics, and dynamics. Occasionally in the first portion of the book, in order to make himself perfectly clear, the author gives definitions which are rather unnecessarily elementary; for example, is it necessary to say that all the water consumed by vegetation and vapourised is evaporation, and the portion which runs into the stream is the run-off?

The enormous amount of trouble which Mr. von Schon has taken in the compilation of his facts can be seen from the table of rivers, drainage areas, and low monthly flow, which extends from p. 10 to p. 26, and, of course, there are many other tables and diagrams interspersed throughout the volume.

Chapter ii. is entitled "Power Opportunity," meaning to say the possibilities of obtaining water from

any given source, and the author shows how the flow deductions can be estimated from the precipitations, that is, the amount of water obtained from rainfall, &c. He points out how, in one case, the failure to study this caused a syndicate to credit a certain source of output with 3500 h.p., where, as a matter of fact, the "opportunity" was good for about 1500 h.p., with 250 h.p. auxiliary plant to supplement the three months' low-flow output. It will be seen, therefore, that the reading of this book will help to prevent the investor from putting his money into "wild-cat schemes."

Part ii., as already mentioned, is for the practical man, and certainly contains too many formulæ for the uninitiated, although these are absolutely essential to the engineer. This portion of the book commences with a survey which embraces all operations by which the hydrographic, topographic, and geological characteristics are investigated.

Having obtained the data furnished by a careful survey, the next chapter deals with the development programme, and this part is remarkably well illustrated by means of line blocks, showing different methods of development; for instance, direct development in rocky gorge, short diversion development, distant development, and so on.

The space at our disposal will not allow us to go more fully into this extremely interesting work. The half-tone illustrations of various power houses and power schemes are exceedingly well got up, and are a valuable aid to the reader. It only remains to say that the author is to be congratulated upon having brought out a book which is useful to the general public, and also of great value to the specialist.

SOME NEW CHEMICAL BOOKS

(1) *Technical Chemists' Handbook*. By Dr. G. Lunge. Pp. xv+260. (London: Gurney and Jackson, 1908.) Price 10s. 6d. net.

(2) *Exercises in Elementary Quantitative Chemical Analysis for Students of Agriculture*. By Dr. A. T. Lincoln and Dr. J. H. Walton, jun. Pp. xv+218. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.) Price 6s. 6d. net.

(3) *Laboratory Manual of Qualitative Analysis*. By W. Segerblom. Pp. xii+136. (London: Longmans, Green and Co., 1908.) Price 3s. 6d.

(4) *Synthetic Inorganic Chemistry*. By Dr. A. A. Blanchard. Pp. viii+89. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 4s. 6d. net.

(5) *The Fundamental Conceptions of Chemistry*. By Dr. S. M. Jörgensen. Translated by M. P. Appleby. Pp. viii+175. (London: Society for the Promotion of Christian Knowledge, 1908.) Price 2s. 6d.

(6) *Kurzes Repetitorium der Chemie*. I., Anorganische Chemie. By Dr. E. Bryk. Breitenstein's Repetitorien, No 7. Pp. iv+244. (Leipzig: J. A. Barth, 1908.) Price 2.85 marks.

(1) DR. Lunge's "Technical Chemists' Handbook" is a new and revised edition of the extremely useful little volume, well known under the title of "The Alkali Makers' Pocket-book," and later as "The Alkali Makers' Handbook." In many respects the new volume, in the preparation of which the author has had the assistance of Dr. Berl, is unlike its predecessors, which were intended mainly for the laboratory of the alkali maker. The scope is greatly enlarged, and covers a variety of industries. The old material is brought up to date, and there are new chapters on water for boilers, on coal gas and its products, on calcium carbide and acetylene, on fertilisers, aluminium salts, and calcareous cements. The book, although intended for the works, will also be found useful in a college laboratory in training the future professional chemist. It possesses, it may be added, a great advantage over many technical handbooks, for it embodies the results of long personal experience, and, being restricted in its scope, can afford space to enter into the minutiæ of each operation.

(2) The volume by Drs. Lincoln and Walton is intended for agricultural students. The first half is an introduction to the methods of ordinary quantitative analysis, and is written with great care and thoroughness. It might include with advantage a few more gravimetric exercises. The second part is technical, and is devoted to the analysis of milk, butter, food-stuffs, fertilisers, and soils, and concludes with analytical problems and methods of calculation under the title "stoichiometry." There is little which calls for criticism, for the volume is evidently written by experts who are thoroughly *au fait* with their subject. We would only direct attention to the fact that the standards given are mainly those of the U.S. Department of Agriculture, which are not in force in this country. The same may be said of some of the apparatus and methods. The Babcock method is, we believe, not used here, and the Hanus method is a modification of what is generally known as Hübl's method. It might be well to include in a subsequent reprint a figure of the Reichert-Meissl apparatus, and details of dimensions which are essential. The method of estimating potassium in soils is not given in sufficient detail for those special cases where modifications may be necessary.

(3) It is difficult to realise the particular aspect of qualitative analysis which compels teachers to add to the already extensive literature on the subject. It is rarely that one finds a new arrangement, new tests, new apparatus, or new reactions. The order of the groups, the disposition of principal and subgroups, and the general and special reagents, are always the same. We have examined Mr. Segerblom's volume in vain for something new or suggestive. We are inclined to question the utility of general definitions at the beginning of a book, and certainly some of those given are not very happy. "A reaction," we are told, "is any phenomenon exhibited by a substance." According to this, the breaking of glass would be a reaction. Although there is nothing that strikes one as new, it may be said that the description of the different operations is full and clear; the book is excellently printed, and there is a useful appendix of "study questions" to beguile the student's leisure.

(4) The little volume entitled "Synthetic Inorganic Chemistry" contains a description of a series of simple preparations of metallic compounds, and is

designed for the use of students in their second college term. Each preparation is introduced by a short theoretical discussion of the reaction involved, followed by details of procedure, and a number of suggestive questions which the student is required to answer in his note-book. The scheme is excellent, and if conscientiously followed should afford an intelligent student the full benefit of each experiment. He is not supposed to work right through the book, but the experiments are to be distributed among the students, who are encouraged to be inquisitive as regards their neighbours' activities, and so acquire indirectly all that the book contains. Considering that the matter is not very original, that there are no illustrations, and only eighty-nine pages of print, the price of 4s. 6d. seems rather high.

(5) If "The Fundamental Conceptions of Chemistry" were printed as an *aide-mémoire* for a candidate for the Inter. B.Sc., we should consider that the 179 small pages of compressed general chemistry might serve a useful if not very dignified purpose. The book is full of facts and theories laid down in didactic fashion and with that want of precision and clear exposition which characterise the tutorial text-book. We cannot agree with the author that the book will "accustom the student to the methods of chemical reasoning," unless, of course, chemical reasoning is, as one is sometimes inclined to think, a different mental process from other kinds of reasoning. Nor do we agree with him in admiring the elegance displayed in the get-up of his book. We must, however, commend one special feature, namely, the historical references, which are numerous and generally accurate. It is interesting to learn the Christian names of chemists, who do not usually appear to have any. Such, for example, are Cato Maximilian Guldberg, Peter Waage, and Eilhardt Mitscherlich; Dulong and Petit are, however, coupled together, as usual, without Christian names. We should dissent from Dalton being described as a Manchester schoolmaster, and from the statement that owing to the discovery of oxygen, "Lavoisier was able to realise what Mayow's genius had arrived at a hundred years before."

(6) Dr. Bryk's "Repetitorium" is what it professes to be—a mere compilation of important facts to assist the student's memory. It has been put together apparently with great care, and there are many useful tables containing a general summary of compounds of different elements. To anyone desirous of assimilating large quantities of information, the book may be safely commended; but we cannot promise that he will be intellectually stimulated by its perusal.

J. B. C.

OUR BOOK SHELF.

Experimental Elasticity. A Manual for the Laboratory. By G. F. C. Searle, F.R.S. Pp. xvi+187. (Cambridge: University Press, 1908.) Price 5s. net.

THE author has embodied in this volume in a connected form the contents of a number of manuscripts which he had from time to time written for the use of students attending his class in practical physics at the Cavendish Laboratory. Chapters i. and ii., consisting of 70 pages, give an account of the elementary theory of elasticity, with solutions of some special mathematical problems. Chapter iii., pp. 71–161, describes the experiments—numbered 1 to 14—prescribed for the student. Pages 162–183 comprise ten short notes, mostly on mathematical subjects. There is a table of contents and an index.

The experiments, which relate mainly to the determination of Young's modulus and the rigidity in materials assumed isotropic, are very carefully described. The apparatus, which seems mostly designed by the author, is usually simple, and the student who goes through the course intelligently should have learned a good deal. The illustrations of Saint Venant's principle of "equipollent" systems of force in chapter ii., due to Dr. Filon, are likely to be useful.

Notwithstanding the merits of the book, it is a little difficult to picture a student for whom it would form the best possible introduction to the subject. The reader who requires the notes at the end seems hardly likely to follow the mathematical investigations into the differences between adiabatic and isothermal elasticity in chapter i., or into the bending of a rod and the bending and twisting of a blade in chapter ii. The ordinary student would probably get a better grasp of the mathematical theory of elasticity from a study of the ordinary stress-strain and surface equations, and their application to a few really simple problems.

The author's attitude towards the application of isotropic elasticity to wires leaves something to be desired. On p. 113 he gives a table of values of Poisson's ratio obtained by the method of one of his experiments. In five out of nine cases the value is impossible, exceeding 0.5. The impossibility, it is true, is pointed out, the phenomenon being ascribed to lack of isotropy. But this is much as if a temperance lecturer illustrated the evil effects of intemperance in his own person. A safer course would be to confine the table to cases where isotropy is at least not obviously untenable, adding a warning that wires are frequently neither isotropic nor homogeneous, and that absurd results are often obtained by assuming that they are. It would also be as well to let physical students know that isotropy is not the only type of elasticity amenable to mathematical treatment. Vibrations in thin wires are theoretically a less satisfactory method of finding elastic constants for materials than are vibrations in long rods, but possibly Mr. Searle is reserving vibrations in rods for one of the further volumes adumbrated in his preface.

C. CHREE.

Beautiful Flowers and How to Grow Them. To be completed in 17 parts. Edited by Horace J. Wright and Walter P. Wright. With 100 coloured plates. (London: T. C. and E. C. Jack.) Price 1s. net each part.

THE first part is concerned entirely with roses, and includes twenty-four pages of letterpress. The writer discourses upon roses from the point of view of the garden decorator rather than that of the exhibitor, and, indeed, the mere exhibitor is given very little consideration. This is very natural in such a work as this, which is undoubtedly intended for amateurs who wish to grow flowers for their own sake alone, and not for the glory that attends the winning of prizes at competitive exhibitions.

The style is pleasant, and the reader is given an insight into the classification of roses in order to enable him to understand the characteristics of the numerous types. Even the novice may soon acquire some knowledge of the hybrid teas, teas, hybrid perpetuals, noisettes, moss rose, polyantha rose (*Rosa multiflora*), the Wichuraiana roses (including such esteemed varieties as Dorothy Perkins, Lady Gay, and Hiawatha), and other types. Some of these are

suitable for cultivation in beds and borders, whilst others may be used for adorning pergolas, arches, pillars, summer-houses, or other structures. Directions are given for cultivation and propagation, the process of budding being explained fully and illustrated with appropriate cuts. Those who are not familiar with the varieties will find the selections of roses for different purposes of great assistance in choosing those which will be most suitable for their particular gardens.

The text is large, bold print, and this being upon parchment paper, the convenience of the reader has been obviously studied. The coloured plates have been prepared from paintings of well-known artists, and many of them are pleasing, but others are too impressionist in character, particularly that representing a Dorothy Perkins rose growing upon old trees. The effect of the rosy crimson flowers is depicted, but one cannot in the least trace any rose foliage, and even the plant itself takes no shape, and, therefore, cannot be distinguished.

The second part contains the concluding portion of the letterpress on roses, and the remaining pages are devoted to bulbous plants. The third part is a continuation of the matter concerning bulbs. It contains excellent coloured plates of *Lilium speciosum*, "Christmas Roses and Glory of the Snow," and "Madonna Lilies and Roses." These are the best plates in the third part, and the figure of a church as the background to the last-mentioned picture is an agreeable and appropriate feature.

The Philosophical Basis of Religion; a Series of Lectures. By Dr. J. Watson. Pp. xxviii+485. (Glasgow: J. MacLehose and Sons, 1907.) Price 8*s.* 6*d.* net.

Prof. Watson, who is already well known to philosophical students by his work on Kant, has, by the publication of this collection of lectures, laid a still larger circle of readers under an obligation. The recent congress at Oxford gave sufficient evidence of the present widespread interest in religion as a social phenomenon—an interest largely independent of any attitude towards its claims upon the individual. There will be many scientific students who will turn with profit to Prof. Watson's addresses—admirably lucid as they are, and agreeably free from technicalities—for a treatment of the subject that forms an entirely necessary complement to the comparative method.

The author presents his argument as an attempt to solve the problem of re-building upon a basis of reason the theological beliefs which (he holds) no longer rest securely upon their ancient foundation of authority. The solution he develops takes the form of a "constructive idealism" based upon "the principle that the world is rational and is capable of being comprehended by us in virtue of the rationality which is our deepest and truest nature." The fulfilment of this programme necessitates an examination, first, of typical views on the nature and functions of dogma (such as those of Newman, Loisy, and Harnack), and, secondly, of certain current philosophical doctrines (personal idealism, the "new realism," and pragmatism) that offer solutions of the author's problem which for one reason or another he is unable to accept.

The layman will find Prof. Watson a fair-minded, an interesting, and, on the whole, a trustworthy guide in all these matters, as well as in the lectures on theological history which follow in somewhat loose connection with the rest. He should be warned, however, that the account of the "new realism" given in the fifth lecture contains elements that most of the supporters of that doctrine would repudiate.

Every reader of the book will be grateful for the excellent summaries of the preceding argument which appear at the beginning of most of the lectures.

A Manual of Bacteriology, Clinical and Applied. By Prof. R. T. Hewlett. Third edition. Pp. xii+638. (London: J. and A. Churchill, 1908.) Price 10*s.* 6*d.* net.

The publication of Prof. Hewlett's manual in its new edition serves to remind us of the enormous strides in our knowledge of bacteria which have been made within the last ten years. Bacteriology in its early days meant little more than the study of the morphology of the newly-discovered causes of disease and the search for those undiscovered. Then came the investigation of the poisons manufactured by the organisms; and now the bacteriologist is largely concerned with the substances whereby the organisms are controlled and defeated. Much of the new knowledge of bacteria has come with the discovery that the organisms once believed to be unique are in many cases only members of groups which number dozens or scores of individuals; and the aid of organic chemistry has been invoked to differentiate the members of these groups.

With this constantly widening field of work it has become increasingly difficult to give within a moderate compass an account of our present state of knowledge, and we can therefore all the more congratulate Prof. Hewlett on his success. Within the 600 pages of his book he has contrived to give an adequate account of the methods used in bacteriological research; of the morphology, appearances in culture, and distribution of the chief pathogenic bacteria; of bacterial toxins; of immunity, and the various methods by which it is sought; and, lastly, of the details of disinfection, and the examination of water, air, soil, and milk. He has wisely omitted many of the details of the more complicated methods, but wherever he has done so he has been careful to give a full reference to a source where the reader can obtain the information. In his treatment of some of the more recent work in bacteriology he, in our opinion quite properly, reserves his judgment of its value, while stating fully and fairly the claims advanced. Thus, for example, he still hesitates to accept without reserve the *Treponema pallidium* as the specific organism of syphilis, but adds that the majority of observers hold the opposite opinion strongly.

The illustrations are for the most part reproductions of actual photomicrographs, and are particularly well chosen and clear in outline. The only fault that we have to find with Prof. Hewlett is an occasional obscurity of language; in most instances the context removes any doubt as to his meaning, but in a few cases it is difficult to comprehend. Thus on p. 343 the language seems to imply that there were two dead men who recovered, and though, of course, that is not the meaning, the whole sentence remains obscure, even after the obvious correction has been made.

Ticks. A Monograph of the Ixodoidea. Part i. (Argasidæ). (London: Cambridge University Press, 1908.) Price 5*s.* net.

The study of parasitic and disease-producing Protozoa, which has received such a great impetus of recent years, has caused much attention to be paid also to those groups of animals which, by their blood-sucking habits, are instrumental in transmitting the parasitic organisms from one vertebrate host to another. Ever since Smith and Kilborne first made known the *rôle* of ticks in transmitting Texas-fever in cattle, much attention has been directed to this group of arachnids,

which were subsequently found to be the intermediary for the transmission of the remittent fevers, caused by the presence of spirochætes in the blood, of man in Africa, and of domestic fowls in various countries.

For those who are not experts on ticks, but are made practically acquainted with them from the pathological point of view, a comprehensive monograph or handbook of the group has become an urgent requirement, and this need will now be supplied by the monograph of the Ixodoidea which is being produced by Messrs. Nuttall, Warburton, Cooper, and Robinson. Part i., dealing with the Argasidæ, has appeared, and consists of 104 pages (not including the bibliography of 18 pages), with three plates and 114 text-figures. This monograph will undoubtedly be a most useful publication, and it is to be hoped that this example will be imitated with respect to other groups of blood-sucking invertebrates. A modern comprehensive monograph of leeches, for instance, is also a work urgently needed by those who desire to study the transmission of the blood-parasites of fishes and lower vertebrates.

Who's Who, 1909. Pp. xxiv+2112. (London: A. and C. Black.) Price 10*s*. net.

Who's Who Year-Book for 1909. Pp. vi+154. (London: A. and C. Black.) Price 1*s*. net.

The Englishwoman's Year-Book and Directory, 1909. Edited by G. E. Mitton. Pp. xxvi+372. (London: A. and C. Black.) Price 2*s*. 6*d*. net.

The Writers' and Artists' Year-Book, 1909. Pp. vii+121. (London: A. and C. Black.) Price 1*s*. net.

THESE four works of reference are so well known and widely esteemed that it is hardly necessary to say more than that each maintains its high level of excellence. "Who's Who" continues to increase in bulk; this year there are 72 pp. of additional matter, indicating the editor's desire to make his roll of honour as comprehensive as possible.

The "Who's Who Year-Book" is made up of the tables which were formerly published in "Who's Who," with many new lists, including, we notice, one of the Nobel prizes awarded since 1901.

Every particular of importance about the useful work women are doing is to be found in the "Englishwoman's Year-Book and Directory"; and as the Editor remarks, "no woman who takes any part in public or social life can afford to be without it." Even a glance through the volume will serve to show that women are making notable contributions to knowledge, and taking an honourable part in every form of activity intended to improve the conditions of human life.

The title of the fourth year-book sufficiently describes its scope; the volume should prove of great assistance to young writers and artists.

Arcana of Nature. By Hudson Tuttle. With an Introduction by Dr. Emmet Densmore. Pp. 471. (London: Swan Sonnenschein and Co., 1908.) Price 6*s*. net.

DR. DENSMORE's introduction includes memoirs of Emanuel Swedenborg, A. J. Jackson, Hudson Tuttle, Cora Richmond, and W. J. Colville; and this fact—since all are described here as "psychics"—will serve to indicate the scope and character of the volume. "The Arcana of Nature" was published in 1860, and its subtitle, "The History and Laws of Creation," shows its ambitious aim. Dr. Densmore has been impressed with the phenomena to which attention is directed in this volume, and he feels they deserve consideration "from the psychic student as well as from the general public."

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Flying Machines and their Stability.

IN the early part of this year I suggested in a letter to NATURE (vol. lxxvii., p. 293, January 30) that it would be desirable for experimenters with flying machines to direct their attention to automatic stabilising appliances, and the character of the accidents which have occurred since that letter was written tends to emphasise the importance of this.

Among the six degrees of freedom possessed by any body free to move in three dimensions, viz. $\dot{x}$, $\dot{y}$, $\dot{z}$, $\dot{\theta}$, $\dot{\phi}$, $\dot{\psi}$ (x being horizontal in the direction of motion, y and z horizontal and vertical, and $\dot{\theta}$, $\dot{\phi}$, $\dot{\psi}$ angular velocities about x, y, and z), $\dot{x}$, $\dot{y}$, and $\dot{z}$ may be controlled by hand, but for steady motion it is requisite that $\dot{\phi}$ and $\dot{\psi}$ should be zero except when the course is changing, and $\dot{\theta}$ should be zero except when the horizontal curvature of the course is changing.

Of these angular velocities, any of which may be caused by instability, $\dot{\theta}$ is the most dangerous, and it is to the automatic extinction of this that attention should be directed in the first place. (This is the form of instability which most kites suffer from in strong winds.) $\dot{\phi}$ may be a source of danger if the pitching or diving is considerable, but $\dot{\psi}$, which corresponds to a wandering course in the horizontal plane, may be dealt with by steering.

There can be little doubt, I think, that for aëroplanes the best method of correcting for $\dot{\theta}$ is that adopted by the Wrights, namely, the alteration of the relative inclination of the wing surface on either side. In this they are following the practice of the long-winged birds, but the control should be automatic.

Automatic control of the wing surfaces could be effected by any device which would copy with power the position of a short pendulum without exerting any force on the pendulum itself.

The pendulum must be short, because $\dot{\theta}$ must be related, not to the absolute vertical, but to the direction of the resultant of gravity and the centrifugal force due to the horizontal curvature of the course (whatever that may be), and a pendulum with a short period and considerable extinction sets itself very quickly in this direction.

It may be remarked that the same class of device could be used for the automatic control of $\dot{\phi}$. The problem here presented offers a large field for invention.

Too much stress is often laid on the particular forms given to the wing surfaces. In reality, flight is possible with almost any form of wing if appropriate surface speeds are used.

In nature flight is conducted in two ways, of which, among birds, the albatross and humming-bird may be cited as extreme examples. With the first of these the body speed must be high, and much power has to be exerted in starting before the economical speed is reached. With the latter the body may be stationary, but the wing speed is always high.

This type of flight corresponds to "lifting screws" on a flying machine, and with this form, I believe, no success has hitherto been achieved. It seems not impossible, however, that with proper balancing appliances it will ultimately prevail, considering what great advantages it offers in the matter of starting and stopping. In the matter of economy of power, also, it is obviously better to use, if possible, the same surface both for support and propulsion rather than separate propellers as aëroplanes must do. If the aëroplanes could propel themselves by flapping their wings, the latter objection would not apply.

A. MALLOCK.

6 Cresswell Gardens, S.W., December 16.

Zeeman Effect in Weak Magnetic Fields.

ACCORDING to Voigt, the displacement of the outer components of the Zeeman triplet plotted against the strength of the magnetic field is represented by a hyperbola, when the light is observed at right angles to the field. The hyperbola approaches asymptotically to a straight line in strong fields, where most of the observations have hitherto been made by different experimenters. Moreover, the intensity of the component towards the red is greater than that towards the violet in weak fields, and gradually tends to equality as the field is increased. Gehrcke and von Baeyer examined the separation of the satellites of the mercury line 546·1 $\mu\mu$ in a field of 535 Gauss, but did not notice the asymmetry as indicated by theory.

On account of the double difficulty of obtaining fine spectrum lines and of using instruments having strong resolving power, the theory of asymmetry in weak fields has not yet been placed under thorough experimental test. When it is impossible to measure the effect on distinctly separated lines, we can infer the nature of the change by measuring the broadening of the lines, provided they are sharply defined. For this purpose, the gold lines $\lambda=627{\cdot}6$ $\mu\mu$ and $\lambda=583{\cdot}5$ $\mu\mu$ are characterised by having sharp edges in the spark spectrum, when the self-inductance and capacity of the circuit are properly adjusted. By using an echelon spectroscope made by Hilger, of resolving power $\lambda/\delta\lambda=430{,}000$ for $\lambda=500$ $\mu\mu$, I made numerous observations with Mr. Amano, and found that the effect for a triplet of the red gold line is measurable in a field of 240 Gauss, and on following the curve to strong fields it is approximately represented by a branch of hyperbola with very short axis, showing a slight bend in $H=3000$, which is probably caused by the asymmetry in the intensity of the component lines. A similar result was obtained with the copper line $\lambda=510{\cdot}5$ $\mu\mu$, which is divided into a triplet. The utmost care was necessary to have the electromagnet producing the field well demagnetised before each experiment, by a special device of alternately passing gradually diminishing current in rapid succession.

With the quartet of the yellow gold line, the nature of the change of the inner components is somewhat similar to the triplet before mentioned, but the curvature is more pronounced. The displacement of the outer components is more complex in weak fields, but from $H=5000$ upwards it keeps approximately linear relation with the field. Similar observation was also made with the magnesium line b_2.

The principal source of error in the present experiment is the uncertainty as to the difference in the intensity of the component lines; this will no doubt affect the breadth of the superposed lines. When the lines are separated by applying sufficient magnetic force, the difference in the breadth and intensity of the components is not to be distinguished by mere eye observation.

H. NAGAOKA.

Physical Institute of the University of Tokyo,
November 25.

Women and the Chemical Society.

THE council of the Chemical Society, at a recent meeting when it was determined to exclude women from the fellowship, but to admit them to the society as "subscribers," decided, "after mature deliberation"—the phrase is the senior secretary's—that the appellation "subscriber" should be printed with a big S!

Daughters of Eve! So zealous to pursue
The work in Life by which you seek to live!
When F.C.S. you claim, as is your rightful due—
The S alone is what they, grudging, give!

Be patient! Time is on your side.
Reason and justice will your cause defend.
Ignoble spite and arrogance of pride
Shall meet their retribution in the end!

T.

Autumn, and After.

THE following table may be of interest at the present time. It indicates the years in which (as in this) all three months of autumn have been dry at Greenwich (1841–1907), and the character, as regards temperature, of each of the three months of winter following (+ meaning warm and – cold).

	December	January	February
(1) 1847	+	–	+
(2) 1850	+	+	+
(3) 1851	+	+	+
(4) 1854	+	–	–
(5) 1858	+	+	+
(6) 1868	+	+	+
(7) 1881	+	+	+
(8) 1884	+	–	+
(9) 1890	–	–	–
(10) 1900	+	+	–
(11) 1901	+	+	–
(12) 1902	+	+	+
(13) 1904	+	–	+
Warm	12	8	9=29
Cold	1	5	4=10

Three things may here be noted:—

(1) December has nearly always been warm (twelve cases out of thirteen).

(2) In the total of the winter groups, warm months have been about three times as numerous as cold (twenty-nine to ten).

(3) Excepting 1854–5 and 1890–1, each winter has had two or three months warm.

The present December promises (December 15) to be warm. What the season as a whole will bring forth remains to be seen.

ALEX. B. MACDOWALL.

THE DARWIN COMMEMORATION AT CAMBRIDGE (JUNE 22–24, 1909).

THE Darwin Celebration Committee appointed by the Council of the Senate to make the necessary arrangements has issued invitations to a large number of British and foreign universities, colleges, academies, and learned societies. The committee has already received the names of nearly 200 delegates who propose to attend the celebration in June. Among those nominated by universities and societies in the United States are the following:—Prof. Baldwin (Johns Hopkins University), Prof. Loeb (University of California), Prof. Farlow (American Academy of Arts and Sciences), Prof. Minot (Boston Society of Natural History), Prof. Coulter (Chicago University), Dr. Davenport (Cold Spring Harbour Experimental Station), the president of Cornell University, Prof. Chittenden (Yale University), Prof. Peck (the Connecticut Academy), the president of the Academy of Arts and Sciences (New York), Prof. E. B. Wilson (Columbia University), Dr. Biggs (New York University), Dr. Harrison (University of Pennsylvania), Dr. A. E. Brown (Philadelphia Academy), Dr. Osborn (American Philosophical Society), the president of the Carnegie Institute (Pittsburg), the secretary of the Smithsonian Institute, the president of the Carnegie Institute (Washington), Dr. Howard (Academy of Sciences, Washington).

The University of Chile, Santiago, is to be represented by the Envoy Extraordinary of Chile. From Austria-Hungary the following are expected:—Prof. Ludwig von Graff (Gratz), Prof. Apathy (Kolozsva), Prof. Vejdovsky (Prague), Dr. Steindachner and Prof. Wettstein (Vienna). The Belgian delegates include M. Laneere (pro-rector of the University of Brussels), Prof. van Beneden and Prof. Dupont (Brussels), Prof. Dorlodot (Louvain). Prof. Höffding and Prof. Jungersen are coming from Copenhagen. Among French delegates are Prof. Malaguin (Lille), Prof. Cuénot (Nancy), Prof. Dantec (University of Paris), Prof. van Tieghem, M. Perrier, Prinee Roland Bonaparte (Institute of Franee), Prof. Papillaut, Prof. Metchnikoff, Dr. Manouvrier (Paris).

From Germany the following names have been received:—Prof. Stumpf, Prof. Waldeyer, Prof. Diels, Prof. Engler, Prof. Hertwig, Prof. von Luschan (Berlin), Prof. Schultze (Bonn), Prof. Kukenthal (Breslau), Dr. Roediger (Frankfurt), Prof. Verworn and Dr. Berthold (Göttingen), Prof. Bütschli (Heidelberg), Prof. Haeckel (Jena), Dr. R. Hertwig and Prof. Goebel (Munich), Prof. Ballowitz (Münster), Prof. Graf zu Solms-Laubach (Strassburg), Prof. Boveri (Würzburg).

Prof. Zeggelis will represent the National University of Athens. The delegates from Holland include Prof. de Vries, Dr. Kerbert (Amsterdam), Prof. van Bemmelen (Groningen), Dr. Lotsy (Haarlem), Prof. Vosmaer (Leyden), Prof. Hubrecht (Utrecht). The Italian Ambassador is to represent the Geographical Society of Italy; English delegates have been nominated by the University of Catania, the Società der Naturaliste of Modena, and the Accademia dei Lincei; the Universities of Siena and Turin have nominated Sig. Achille Sclavo, Dr. Fritze, and Sig. Renier.

Prof. Kuwaki and Prof. Ishikawa are nominated by the Universities of Kyoto and Tokyo respectively. The University of Christiania is to be represented by Prof. Brögger. The Portuguese delegates are Prof. Henriques (Coimbra), Dr. Telles (Lisbon), Dr. Lacerda (Porto). The Russian delegates include Prof. Kuznetsov (Dorpat), Prof. Timiriazeff (Moscow), Prof. Simkevic, Prof. Zalenskij, Prof. Borodin (St. Petersburg). Prof. Elfving is nominated by the Finnish Academy of Helsingfors. The Swedish delegates include Prof. Forssman, Prof. Nordstedt (Lund), Prof. Théel, Prof. Aurivillius, Prof. Leche, Prof. Nathorst, Prof. Mörner (Stockholm), Prof. Sven G. Hedin (Upsala).

The delegates from Switzerland are Prof. Tschirch (Bern), Prof. Chodat (Geneva), Prof. Béraneck (Neuchatel), Dr. Sarasin (Zurich).

Delegates have been appointed also by colonial universities and societies, and by universities, colleges, and numerous societies in the British Islands.

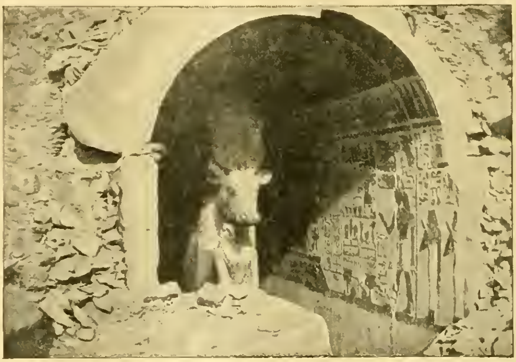
It is expected that the Chancellor of the University (Lord Rayleigh, O.M.) will hold a reception on the evening of June 22. On Wednesday, June 23, the delegates will present addresses in the Senate House; in the afternoon the master and fellows of Christ's College (the college of Charles Darwin) propose to give a garden party in the college grounds, and in the evening the guests of the university will be invited to a banquet. On Thursday morning, June 24, the Rede lecture will be delivered in the Senate House by the president of the Royal Society (Sir Archibald Geikie, K.C.B.).

A list of British delegates and other invited guests, containing additional names of foreign visitors, will be prepared at a later date. A. C. SEWARD.

NEW LIGHT ON ANCIENT EGYPT.[1]

"IT is impossible to understand the Present unless one knows the Past." This aphorism, trite enough, is in danger of being forgotten nowadays. Yet there are some who realise that we cannot properly understand nature's highest work, man, as he exists to-day, without knowing something of his history; and by that is not meant a catalogue of kings' names, battles, and dates (the "history" that is taught in most of our schools), but the story of the development, the evolution of human civilisation. It is only of late years that the history of Greece and Rome, of the civilisation which is still our own, has begun to be treated from this point of view; and the impetus to the new way of looking at things has undoubtedly been given largely by the scientific study of the results of archæological exploration in Egypt, Assyria, Greece, and Italy. The application to these discoveries of the methods of study that are, as a matter of course, used in dealing with natural science has had the consequence of revolutionising our views of ancient story; and as most of the spadework has been done in Egypt, it is Egypt that has told us most of our new knowledge.

In the present book Prof. Maspero has collected a number of articles that have appeared over his signature at various times, dealing with all the most important Egyptological discoveries, whether made by English or American spades in temples and tombs,



The Shrine and Cow *in situ* at Deir-el-Bahari. From "New Light on Ancient Egypt."

or by German pairs of spectacles in papyri and inscriptions, during the last fifteen years.

No pen could describe them with more effect and with more literary grace than a French one, especially when it is wielded by the greatest master of Egyptological science.

The result, as Prof. Maspero says in his note at the beginning of the volume, is a "living picture" of Egyptian research during almost two decades.

It is a kaleidoscopic picture that is presented to us. We see temples, like Deir el-Bahari, white and glistening against red cliffs and blue sky, or, like Bubastis, ruined wastes of red granite chips amid the sand dunes. We explore, candle in hand, and with lowered head, the windings of tombs far beneath the earth, half-stifled by heat and foul air, until we at last reach royal interments four thousand years old, but still shining with gold and colour. We read the triumphal stela of Pharaoh Meneptah, the son of Rameses II., who tells us how he smote the mighty men of Israel in the hills of Mount Ephraim; this is the first mention of Israel in "secular" history. We see the priest-worked statue of the great god Khonsu-in-Thebes-Beautiful-Rest nodding its head "vigorously, vigorously," when Pharaoh Rameses asks if the god's smaller and port-

[1] "New Light on Ancient Egypt." By G. Maspero. Translated from the French by Elizabeth Lee. Pp. xii+315; illustrated. (London: T. Fisher Unwin, 1908.) Price 12s. 6d. net.

able image shall be sent to the far land of Bakhtan to cure the sick daughter of the king of that country. We read how an Egyptian statesman of the reign of Amenhetep III., Amenothes, son of Paapis, was deified by popular superstition after his death, and was eventually admitted to the pantheon. We see a half-comic kinematograph picture of a donkey driven by a fellah and accidentally kicking a half-buried pot, out of which falls the rich golden and silver treasure of Tûkh-el-Garmûs, now one of the "show pieces" of the Cairo Museum. We see the falling stones revealing the shrine in which stands the Hathor-cow of Deir-el-Bahari, once more greeting the light. We read an ancient Egyptian medical treatise and the philosophical dispute of an Egyptian with his own soul. So the pictures change swiftly, and the showman explains them with winged words.

The book is translated, on the whole, extremely well. There are, however, some faults in it. On p. 104, "l'impératrice Sabine" is translated "the Sabine Empress" (!) instead of "the Empress Sabina." This is dreadful, as is also "at Cyprus" on p. 51 for "in" Cyprus. One does not say "at England," though one has noticed "at Crete" in the newspapers lately. "Malgache chiefs" (p. 225) are, in English, Malagasy. But blemishes of this kind can be taken out in a second edition of the book, which, it is to be hoped, will appear in a few years' time with additions, and with one or two articles, which are somewhat out of date, such as that on "Archaic Egypt," omitted.

H. R. Hall.

A PIGMENTATION SURVEY OF SCOTLAND.[1]

All interested in anthropology and sociology will welcome the recent increase of interest in and the renewal of extensive investigations into the physical characters of the population of the British Isles. The report by Mr. J. F. Tocher on the latest investigation, "A Pigmentation Survey of School Children in Scotland," carried out under the auspices of a committee of the Royal Society, is the most important that has appeared since the publication of Beddoe's "Races of Britain," which forms the basis of our knowledge of racial distribution in these islands. The general and local distribution of colour traits in the children has been accurately recorded, and the influence of various factors of race and environment determined.

The completion of this report is most timely in view of the survey of the school children of England and Wales now being undertaken under the Education Act of 1907. The Board of Education, in its circular, only requests information as to the stature and weight of the children, but it may be hoped that one result of the present publication may be the addition to the schedule of observations on the hair and eye colour, without which all evidences of race are lost and the whole investigation is rendered incomplete and possibly even misleading.

The Scotch survey was carried out by sending schedules and instructions to the masters in all the schools. These, fortunately, took the matter up so enthusiastically that returns comprising information as to some half-million children were sent in, for which they will receive the sincere thanks of all anthropologists, who are only too conscious that without the cooperation of the teachers no survey could be even attempted. The hair colours recognised were red, fair, medium, dark, and jet black; the eye colours, pure blue, light, medium, and dark, so that the schedule closely resembled that used by Beddoe. It was found after many experiments that satisfactory lithographic reproductions of the standard colours could not be reproduced, so that the returns refer to descriptions, not actual matches of the hair and eyes. It has, however, been shown that classifications based on written descriptions agree sufficiently closely with those obtained by actually comparing each child with standard samples of hair and artificial eyes.

The schedules having been received, the actual proportion of children in each colour class in each locality was determined, the divergence from the figures for the whole of Scotland being noted. By somewhat elaborate calculations it was ascertained whether these divergences were such as might have occurred in a chance sample of the whole population or were significant of the action of definite factors affecting the local type of pigmentation.

The Orkney and Shetland Islands, Lewis, eastern Caithness, the eastern boundaries of the Highlands, Lothian, and the Border counties contain a significantly fair child population. A significant excess of dark hair characterises the Highlands, Galloway, and the city of Glasgow. Jet-black hair is found in excess in the Highlands. Brown or medium hair is the feature of all densely populated areas. Red hair is only in excess among the populace to the north of the Grampians and to the east of the Caledonian Canal. The author points out that it is significant that this area should have been the home of the opponents of Agricola described by Tacitus as rufous. The fair-haired districts correspond to the areas occupied by the Scandinavian or Nordic race, and present another northern feature in the significant excess of pure blue eyes.

The characters of the Gaelic-speaking population were specially investigated, with the result that an excess of dark and jet-black hair was found. A large proportion of blue eyes was also discovered, possibly in part explained by intermixture of non-British elements now speaking Gaelic.

Glasgow was found to present such divergences from the general population as to require a special study. In no division of the city was there an excess of fair hair; medium hair was present in excess throughout the city and to a less extent in the suburban areas. Dark and black hair was found with unusual frequency in the Gorbals and Tradeston districts. Dark and medium eyes were significantly more prevalent in the more densely populated districts. Glasgow thus agrees with London and most Continental cities.

Tocher shows that three factors may be concerned in this selection. The darkening of the hair with age might take place earlier among fair-haired city children, and the process might be more intense. For this there is at present no evidence. The medium class might be the more fertile. The author shows that the number of births per family is greater than the average in areas characterised by an excess of medium hair and eyes, while it is below the average in areas in which fair hair and blue eyes are in excess.

Lastly, the excess of medium traits might be due to blending. The offspring of parents, one fair, the other dark, tend to present hair colours in the proportion of one fair, one dark, and two medium, which corresponds with the numbers found in densely populated areas. In the case of eye colours such blending does not seem to occur, so that the excess of dark and medium eyes in towns can only be explained by the preponderance of these colours among the poorer

[1] "Pigmentation Survey of School Children in Scotland." By J. F. Tocher. From *Biometrika*, a Journal for the Statistical Study of Biological Problems, vol. vi, Nos. 2 and 3. (Cambridge: University Press, n.d.)

and more fertile classes. The divergence in colour traits noticed in Glasgow is in part due to the presence of a considerable non-Scottish element.

Dark traits seem to be associated with imbecility, blindness, and deafness, because these defects are significantly more frequent in Gaelic-speaking districts than in Scotland as a whole. This is perhaps explained, as the author suggests, by the greater emigration of the fittest members of the community from the west than from the rest of the country. The author distinguishes five racial types:—The Scandinavian or Germanic type, with fair hair and blue eyes; the dark European type, with dark hair and dark eyes, which he subdivides into Mediterranean and Danish; the Scoto-Keltic type, with dark hair and blue eyes; the essentially Scotch type, with medium hair and eyes; and the Caledonian type, with red hair. The Scoto-Keltic, Scotch, and Caledonian types are probably crosses, while the Danish type may probably on further investigation be shown to have affinities to the Alpine race.

After showing that the pigmentation in Scotland is intermediate between that of northern and southern Europe, Tocher adds that even in southern Germany the hair is lighter than in Scotland. This will seem inconceivable to those who have worked in the two countries, while the figures quoted in support of this statement suggest the existence of some misconception of the limits of the terms fair and dark as used by different observers. The author has compared his results with those of Fürst in Sweden and Ammon in Baden, using the headings Fair, Red, Medium, and Dark as equivalent to Blond, Roth, Braun, and Schwarz, regarding Medium as Braun. The Continental use of the term Schwarz is practically identical with Black as used by Beddoe, who differs from Tocher in including therein the very darkest browns, only recognisable as browns in a very good light. This in a large measure accounts for the low proportion of dark hair attributed to Sweden. A further difficulty has arisen in comparing the Swedish Blond with the Scotch Fair. The "Blond" class was constructed by Fürst out of a combination of two others, "Gelb" and "Cendré." While the lighter members of the latter class might be included in the Fair division of Tocher, the darker members overstep the upper limits of his Medium division. Fürst, in his monograph on Swedish hair and eye colour, contrasting his results with those obtained by Sören Hansen and Westergaard from Danish children, compares his Braun class with the Dunkel class of the latter authors, and his Blond with their Hell and Mittel classes combined. Sören Hansen's divisions, Roth, Hell, Mittel, Dunkel, and Schwarz, are practically identical with those of Tocher.

When Blond—that is, Gelb+Cendré or Hell+Mittel—is regarded as equivalent to Fair, Braun to Medium, and Schwarz to Dark+Black, the Scottish results naturally show a different distribution from that obtaining in the rest of Europe.

The real comparative tables give the percentage distribution of hair colours as:—

Sweden (adult males)		Denmark (children)		Scotland (boys)		Baden (adult males)	
Gelb ...	23·3	Hell ...	41·8	Fair ..	24·9	Blond ...	41·6
Cendré...	52·0	Mittel ..	40·9	Medium .	43·3	Braun ..	38·7
Braun ...	21·6	Dunkel...	13·0	Dark ...	25·0	Schwarz .	18·0
Schwarz .	0·8	Schwarz .	1·4	Jet-black.	1·2	Roth ...	1·7
Roth ...	2·3	Roth .	2·9	Red ...	5·5		

The distribution in Scotland, then, agrees with that of Europe, and falls into position between Sweden and south Germany. The fact that the data cannot be directly compared points out the urgent need for an international nomenclature, or at least for international standards and authorised translations.

One of the most interesting features of the present survey is that it tends to show that the population of Scotland might have been derived from original blond and brunet elements in approximately equal proportions which are gradually blending to form a distinctive Scottish type.

Further details and correlations are promised by the author for some subsequent publication, and will be anxiously awaited, since, for completeness of detail and thoroughness of statistical investigation, the present memoir is unequalled. It is to be hoped now that the chance exists that the results of a similar survey may in time be available for England and Wales.

THE NEW WIRELESS TELEGRAPH STATION.

As mentioned in our notes columns of December 17, the new wireless telegraph station at Bolt Head, South Devon, was opened by the Postmaster-General on December 11. This station is the first belonging to the Post Office to be opened for a regular service of communication with ships at sea, and has telegraphic connection with Exeter, through which town all messages will be transmitted. In accordance with the provision of the International Radio-telegraphic Convention of 1906, the station will establish public communication with all vessels carrying wireless telegraphic apparatus irrespective of the system of wireless telegraphy which they may have installed. The range of the station is 250 miles, though it is not anticipated that the general working range required will exceed about 100 miles. The cost of communication is expected to average about 8*d.* per word, made up of a shore charge of $3\frac{1}{2}$*d.* and a ship charge of 4*d.*, and the usual $\frac{1}{2}$*d.* per word for the ordinary land rate.

The station is fitted with apparatus on the Marconi system. The aërial, which is 160 feet high, consists of two central conductors and four arms radiating to small poles placed around the main mast, thus being of what is now known as the "Umbrella" type. Power is obtained from a 3-kw. alternator supplying current at 100 volts 50 cycles, which is transformed up to 15,000 to 20,000 volts. The alternator is coupled to a direct-current machine, which can be run either as a motor, or as a generator driven by an 8-h.p. oil engine when it is required to charge the cells, in which case current can at the same time be taken from the alternator. The battery is also used for the lighting of the building. The signalling is effected by a key in the generator circuit which controls a magnetic key which only allows the alternator circuit to be open when the current is at zero, as is now usual with wireless telegraphic work where the power is supplied by an alternator in order to avoid sparking at the contacts of the signalling key. The sparking gap is of the standard Marconi type, and can be varied in length from 2 mm. to 8 mm.; it is completely enclosed in order to deaden the noise of the sparking.

The receiving apparatus consists of a Marconi magnetic receiver, which gives telephonic signals in the usual way, and a coherer circuit for calling up, which is disconnected when receiving signals on the magnetic receiver. The coherer circuit can also be used in connection with a Morse inker to record messages when the operator is not present.

The normal wave-length is 600 metres, but this can be varied, and apparatus is provided to enable the

circuits to be tuned accurately in order to obtain the clearest signalling.

Whilst this is the first State-owned station to be used for public purposes, it may be mentioned that the Marconi Company owns eight such stations which have been open for public communication since the Radio-telegraphic Convention came into force. It will be recollected that the Marconi Company somewhat strongly opposed this convention before ratification on the ground that it would destroy the business which they had built up, an opposition which, as we pointed out in Nature at the time, appeared to be short-sighted and against the public interest. It is gratifying to learn that the company has loyally accepted the convention, and has steadily cooperated with the Post Office in carrying out its provisions, with what are stated to be beneficial results both for the company and the public, the traffic dealt with having increased in volume and the ships carrying Marconi apparatus having increased in number. Everyone will welcome this further evidence of the development of the utility of wireless telegraphy.

M. S.

SWEDISH HYDROGRAPHICAL AND FISHERY INVESTIGATIONS.[1]

Although it did not need the existence of an International Council to point out the field for physical and biological research offered by the waters of the Baltic, there is no doubt that during the last few years of cooperative investigation great strides have been made in our knowledge of the hydrographical and correlated biological conditions of this sea, which presents phenomena of peculiar interest which do not exist in the case of the more economically important North Sea.

The third volume of the "Svenska Hydrografisk Biologiska Kommissionens Skrifter" contains the results of the investigations made by the Swedish men of science Pettersson, Trybom, Schneider, and Broch, up to the end of 1907.

The first-named describes and discusses at some length the results of his observations upon the water-circulation between the ocean and the Baltic, for the proper understanding of which it is necessary to measure the force of the in- and outgoing currents at the entrances to this sea. This the author has carried out by the use of his "Universalsinstrument," an apparatus designed to indicate the direction and velocity of the current, and, at the same time, to take plankton and water samples at a particular depth. The chief determinations were made at stations in the Great Belt at depths of 5, 10, 20, and 30 metres. In general, the water circulation in this channel consists of an outflowing surface current of low salinity and an undercurrent of high salinity entering from the Kattegat, with an intermediate layer of "mixed" water. Pettersson's work has shown in definite terms the various degrees to which these different layers are affected by the influence of daily tidal movements and also by the annual oscillation of Atlantic water—the Gulf Stream flood—and his chief result is to demonstrate that these oceanic factors are of far greater importance in their effect upon the water circulation of the Baltic than had hitherto been suspected from surface observations. In general, the water-layers at 10 m. and 20 m. depth move in opposite directions, except at the time of strongest ebb-tide, when the whole of the water moves seaward. For example, a series of observations at a station in the Great Belt give during flood-tide at 10 m. depth an average velocity of 8.0 cm. per second from south to north, and at 20 m. depth an average velocity of 27.6 cm. per second from north to south; during the ebb-tide an average velocity of 69.2 cm. per second, and at 20 m. of 9.7 cm. per second, both the latter being from south to north. The boundaries between water-layers of certain salinity are not horizontal, but the masses are wedge-shaped and are much closer together in the Kattegat than in the inner sea. The surface movements of the Baltic do not depend so much upon the influence of fresh-water supplies from the rivers, but are the results of forces set up by the intrusion below of ocean water of greater density, the effect of which is to cause a circulation of water from the lower layers to the surface. The interesting circumstance that the dissolved oxygen in the surface water is of distinctly greater amount in the inner (northern) Baltic than nearer the southern entrances is explained by reference to the fact that the southern water has a longer course as an undercurrent than is the case in the northern Baltic. The Little Belt was found to consist of "mixed" water practically homogeneous in temperature and salinity, the flood-tide passing the channel with almost equal velocity at all depths, while the ebb is swiftest at the surface. The Sound showed only one outflowing current of homogeneous Baltic water.

It is in their relation to hydrographical conditions that Dr. Schneider's observations on the distribution of pelagic eggs and larvæ of the food-fishes are of special interest. Under the particular physical conditions which prevail in the Baltic, the *vertical distribution* of these forms is characteristic. Pelagic teleostean ova were taken at considerable depths and were practically absent at the surface. Variation in depth distribution was shown for different species, and the same species was found at different depths in different months, while larvæ occurred, on the whole, nearer to the surface than the ova. The possibility of the existence of cod-larvæ in the northern waters of the Baltic is proved by new positive evidence of their occurrence, though in no great numbers, and a previously accepted theory that they only immigrate at a later stage is corrected. On the other hand, while it has been stated that the plaice stock of the Baltic is self-contained and needs no replenishing from other seas, the writer especially notes the absence of plaice larvæ from the catches of the Swedish expeditions, but draws no conclusion from this negative evidence, and leaves open the question as to whether, and at what stage, there is an immigration of plaice fry from the west.

Trybom contributes additions to the record of experiments with marked flat-fish and lobsters, and in collaboration with Schneider describes experiments with marked eels which have given interesting results. The eels showed practically without exception an oceanward tendency in their migration, moving in a southerly and westerly direction along the Swedish coast and through the Sound. The high rate of 104 km. travelled in two days was shown by one fish, and ten out of the 63 re-captured, from a total of 300 liberated, travelled at an average rate of more than 20 km. per day. Incidentally, these experiments tend to prove the assertion of fishermen that bright moonlight is unfavourable to the capture of eels.

The result of a long series of observations made by Trybom in the river Dalelf upon the piscine enemies of salmon and trout ova is to brand the grayling as by far the most guilty of spawn-devourers. Small trout prey upon the ova of their own and other species of Salmonidæ, and Coregonus, particularly when "spent," is destructive to its own spawn, though seldom found with salmon or trout eggs in its

[1] "Svenska Hydrografisk Biologiska Kommissionens Skrifter III." (Göteborg: Wald. Zachrissons Boktryckeri A.-B., 1908.)

stomach. The coarse fish—bleak, burbot, pike, bream, ruff, and lamprey—were found to be much less harmful, and roach and perch quite innocent of spawn-eating.

In an exhaustive account of the herring collection at the Göteborg Museum, Hjalmar Broch gives an analysis of 354 specimens according to locality, size, age, sex, and maturity, accompanied by a brief dissertation upon fish-scale investigation by means of which not only age, but also, in the case of the herring, racial characteristics can be determined. The same writer reports upon the distribution and age groups of Gadidæ, Pleuronectidæ, Homarus, &c., in the Gullmar Fiord.

Questions of wider interest than Baltic Sea biology are touched upon in an appendix which sets forth the scheme, recommended by the Swedish members of the International Council for the Investigation of the Sea at their meeting in Lübeck in 1906, for the establishment of an international agreement for the purpose of protecting and increasing the plaice stock of the North Sea and neighbouring seas. According to the present state of this fishery, and in the light of the knowledge of the life-history of the plaice, which the current researches have already afforded, it is stated that there is a need for the regulation of fisheries by international agreement, based upon scientific investigations, hydrographical and biological, as well as statistical. A size-limit below which plaice should be forbidden to be landed is the essential remedy recommended, and it is suggested that a progressive limit from 28 to 33 cm. should be agreed upon as the standard for plaice caught by deep-sea fishing, while coastal fisheries should have their special limits according to local conditions. The volume concludes with an appreciative review of the work done by those participating in the International Fishery Investigations, and suggestions as to the trend of future researches.

A. E. H.

NOTES.

The council of the Röntgen Society has now decided to act upon the advice of the committee appointed in 1906 to consider the possibility of preparing a standard for the measurement of radio-activity. This committee recommends that "The γ-ray ionisation from 1 mg. of pure radium be regarded as a standard, and called a unit of radio-activity." The council has deputed Mr. C. E. S. Phillips to prepare a set of three substandards of $RaBr_2$, and these are now maturing. By the kind cooperation of Prof. E. Rutherford, comparison will be made with a specimen of the purest $RaBr_2$ at the Victoria University, Manchester. The quantity of radium in other specimens will be capable of accurate measurement by comparison with the substandards. It is anticipated, therefore, that by this means the exact description of medical, physical, or other work with radium will be facilitated, and that the possibility of fraud in the sale of expensive radium preparations will be eliminated. The council proposes to lend the substandards to any competent person desiring to measure the amount of radium in his possession, or to arrange for authoritative tests to be made. For further particulars application should be sent to the honorary secretary of the Röntgen Society, at 20 Hanover Square, London, W.

A fortnight ago a disastrous railway accident happened in Algeria, and on Saturday last the sad news was announced that the Englishman killed had been identified as Mr. Joseph Lomas, the lecturer in geology at Liverpool University. Mr. Lomas was a well-known British geologist, and was a specialist on Triassic geology; he was making a visit to southern Algeria on behalf of the committee of the British Association appointed at Dublin to investigate the desert deposits of the Biskra oasis in reference to the origin of the New Red Sandstone. Mr. Lomas received his chief scientific education at the Royal College of Science, and in 1884 or 1885 settled at Liverpool as one of the peripatetic science masters of the Liverpool School Board. He soon joined the Liverpool Geological Society and the Liverpool Marine Biological Committee, and gradually took a leading place among the naturalists of that city. He was president of the Liverpool Geological Society in 1896–8, and was recently re-elected for a second term of office, that he might be its president at the approaching jubilee of the society. Though he retained his position under the Liverpool School Board and local education committee, he was appointed in 1887 special lecturer in geology in Liverpool University, and though never on the regular staff, he was responsible for the university teaching in physical geography and geology. He was for nine years one of the secretaries of the geological section of the British Association, and was the recorder for the last two meetings; his trustworthy service and never-failing tact will be greatly missed from that section. After his appointment at Liverpool he began work on the marine Bryozoa of that district; he discovered the presence of calcareous spicules in the Ctenostomata, and was thus led to the suggestion that that group was descended from Bryozoa with a well-developed skeleton. He also prepared a valuable report on the floor deposits of the Irish Sea. Subsequently, he worked mainly at the Trias; he made many interesting additions to our knowledge of the system, and inspired much of the work upon it by the members of the "Trias Committee." He was an enthusiastic champion of the desert origin of the English New Red Sandstone, and defended that theory in papers in the Transactions of the Liverpool Geological Society and the *Geological Magazine*. He was also keenly interested in glacial geology, and made several visits to Switzerland to study existing glaciers. His tragic and early death will be mourned by the wide circle of British geologists who knew his lovable character and his sound and suggestive scientific work.

By the will of the late Lord Rosse, the sum of 1000*l*. is bequeathed to the science schools fund of Trinity College, Dublin. The famous Rosse telescope and all Lord Rosse's scientific instruments, apparatus, and papers are left to his sons in order of seniority successively, whom failing, to his brothers successively, whom failing, to the Royal Society, London; 2000*l*. is left upon trust for the upkeep of the telescope.

The Convocation week meeting of the American Association for the Advancement of Science and affiliated societies will be held in Baltimore from December 28 to January 2. On January 1 a celebration will be held of the one hundredth anniversary of the birth of Darwin and of the fiftieth anniversary of the publication of the "Origin of Species." The celebration will consist of a morning and afternoon programme of addresses by prominent naturalists, to be followed by a dinner in the evening, at which further addresses will be delivered.

The Home Secretary has appointed a Departmental Committee to inquire into the sufficiency of the existing regulations relating to the storage, use, and conveyance of petroleum spirit, and to report what further precautions, if any, are in their opinion desirable as tending to diminish the dangers attendant thereon. The committee

is constituted as follows:—Sir Henry Cunynghame, K.C.B., chairman, Sir Boverton Redwood, F.R.S., Major Cooper Key, and Mr. James Ollis. The secretary to the committee is Major T. H. Crozier, to whom correspondence may be addressed at the Home Office, Whitehall, S.W.

THE Geological Society of Glasgow, instituted in 1858, has now entered the fifty-first year of its existence. The council has made arrangements to celebrate the event by holding a jubilee meeting in Glasgow University on January 28. Sir Archibald Geikie, K.C.B., F.R.S., the senior member of the society, has promised to be present and deliver an address. Sir Donald MacAlister, K.C.B., Dr. Teall, F.R.S., director-general of the Geological Survey of Great Britain, Dr. Horne, F.R.S., Mr. B. N. Peach, F.R.S., and other eminent men of science will take part in the proceedings. A history of the work of the society, with biographical notices of prominent members, is being prepared under the editorship of the secretaries, Messrs. P. Macnair and F. Mort, who hope to issue the book by the end of the year.

HARVARD UNIVERSITY has lost the senior member of her faculty by the death, on December 9, of Dr. Wolcott Gibbs, emeritus Rumford professor of the application of science to the useful arts. Dr. Gibbs, who was a son of George Gibbs, the mineralogist, was born at New York in 1822. After graduating as M.D. at the College of Physicians and Surgeons in that city, he pursued his studies under Heinrich Rose at Berlin, under Liebig at Giessen, and under Regnault at Paris. From 1849–63 he occupied the chair of physics and chemistry at the College of the City of New York. He held his active professorship at Harvard from 1863–87. During this latter period he distinguished himself by his researches in light, heat, and organic chemistry, particularly in reference to complex inorganic bases and acids. His investigations of the platinum metals are also well known. In 1886 Prof. Gibbs was elected foreign secretary of the U.S. National Academy of Sciences, and in 1895 its president. He rendered conspicuous public service on the executive committee of the Sanitary Commission during the Civil War, and was U.S. commissioner to the Vienna Exposition of 1873. He was one of the founders, in 1863, of the Union League Club, which gave valuable help to the Union cause in the struggle with the Confederacy.

THE first number of a very attractive monthly magazine of *Travel and Exploration* has just been published under that title by Messrs. Witherby and Co. The fundamental note of the magazine is that of human interest in the places, peoples, and products of the world. Travel in all its aspects—by land, water, or air—will be dealt with for the benefit of the general reader and the inspiration and guidance of the young explorer. Exploration is a comprehensive word, and can be applied to studies of the heavens above as well as the earth beneath, but apparently the magazine is to be limited to accounts of geographical exploration. In the first number Sir Clements Markham appeals to the spirit of adventure, and Lieut. Trolle describes the Danish expedition to north-east Greenland, which led to valuable scientific results gained at the price of the lives of the leader Erichsen and his two companions. Mr. L. C. Bernacchi predicts that Peru will gradually become one of the richest countries of the world, and Mr. E. S. Bruce describes the progress in the construction and performance of dirigible balloons. There are other contributions upon travel in the Balkans, photography for travellers, and New Guinea, and the pages are brightened with excellent illustrations. The magazine should appeal to a wide circle of readers.

ANOTHER remarkable aeroplane flight was accomplished by Mr. Wilbur Wright at Auvours, near Le Mans, on December 18. The flight lasted 1h. 54m., and the distance covered is estimated to have been more than ninety miles. The flight took place around a triangular course marked with flags at a measured distance apart, and the official record of the number of revolutions around this course gives the distance traversed as sixty-two miles, but the actual track of the aëroplane was often far beyond the measured triangle, thus making the distance much greater. By his achievement, Mr. Wright will probably win the Michelin trophy of 800*l.* for travelling the greatest distance in the air before December 31. He has won the prize of 40*l.* offered by the Aéro Club of Sarthe for the first aëroplane flight at an altitude of 100 metres. The subjoined table, from Saturday's *Daily Mail*, shows the progress made in motor flight with heavier-than-air machines during the past five years:—

Date.	Name	Place	Miles	Yards	Min.	Sec.
1905						
Sept. 28	Wright Bros.	... Dayton ...	11	125	18	8
Sept. 29	Wright Bros.	... Dayton ...	12	—	19	35
Oct. 3	Wright Bros.	.. Dayton ..	15	25	25	5
Oct. 4	Wright Bros.	.. Dayton ...	20	75	33	17
Oct. 5	Wright Bros.	... Dayton ..	24	20	30	13
1906						
Nov. 11	M Santos Dumont	Paris	—	230	21	18
1907						
Oct. 8	Herr Wels	... Trautenau..	—	350ft.	—	
Nov. 7	H. Farman	... Paris	—	1300	—	
1908						
Mar. 22	H. Farman	.. Paris	2	1540	—	
May 14	Wright Bros.	... Manteo ...	6	—	9	—
June 23	M. Delagrange	. Milan ..	10	1105	18	30
July 6	H. Farman	... Paris	11	—	20	10
Sept. 5	M. Delagrange	.. Issy	$15\frac{1}{2}$	—	30	—
Sept. 5	W. Wright	. Le Mans ...	$16\frac{1}{4}$	—	19	50
Sept. 9	O. Wright	... Fort Meyer	$51\frac{1}{3}$	—	56	—
Sept. 9	O. Wright	... Fort Meyer	$37\frac{1}{2}$	—	62	13
Sept. 10	O. Wright	.. Fort Meyer	—	—	65	42
Sept. 11	O. Wright	.. Fort Meyer	—	—	70	30
Sept. 12	O. Wright	... Fort Meyer	45	—	74	20
Sept. 21	W. Wright	... Le Mans ...	58	—	91	25
Sept. 30	H. Farman	... Mourmelons-le-Grand	24	—	36	—
Oct. 6	W. Wright	.. Le Mans ...	42	—	64	26
			with passenger			
Dec. 18	W. Wright	... Le Mans ..	95	—	113	59

THE current issue of the *Fortnightly Review* contains an article by Dr. William S. Bruce on the aims and objects of modern Polar exploration. Supposing the object of an expedition to be a detailed investigation of the North Polar basin, Dr. Bruce gives a sketch of the equipment of such an expedition, the method of procedure, the *personnel* of the staff, and the relations which should subsist between the leader of the expedition and the master of the ship. This investigation is, Dr. Bruce says, the only piece of work in the North Polar regions that remains to be done on an extensive scale, though there is much Arctic work required in other directions. The Beaufort Sea, the islands and channels of the north of the American continent, offer a splendid field for topographical, hydrographical, biological, geological, and other research. Turning to South Polar regions, it is remarked that almost everything south of 40° S. requires a thorough investigation and overhauling, and vast stores of information are to be gathered from both sea and land. It is, in Dr. Bruce's judgment, a study of the sub-Antarctic and the Antarctic seas that requires investigation in the first place, including an exploration and definition of the southern

borders of those seas. More than anything that is required, the paper says, is a new expedition on the same lines as the *Scotia*, and Dr. Bruce is prepared to organise such an expedition as soon as funds are provided. He gives an outline of the way such an expedition might be conducted and the work it might accomplish.

We have been favoured with an advance copy of the forty-seventh report of the Yorkshire Naturalists' Union, containing an account of the proceedings at the forty-sixth annual meeting held at Halifax on December 14, 1907, and of the general working of the society during the past year. Full reports are given of the condition of the bird-life of the county, which are for the most part satisfactory, although the numbers of the great grebe on Hornsea Mere have been sadly reduced by the ravages of egg-collectors.

At a recent meeting of the North Staffordshire Field Club, Mr. F. W. Ash read a paper (of which we have been favoured with a typed copy) on the evolution of the cetacean tail-fin, in which it is attempted to rehabilitate the generally discredited theory that this structure includes vestiges of the hind-limbs as well as the tail itself. The chief argument brought forward in support of the theory appears to be based upon the expanded form and horizontal position of the cetacean flukes, which is likened to the complex formed by the hind-limbs and tail in seals. The tendinous structures in the whale's flukes are considered to represent limb-tendons.

We have received from the publishers, Messrs. Vinton and Co., of Chancery Lane, a copy of the "Live Stock Journal Almanac" for 1909, which is a wonderfully good shillingsworth. The calendar portion contains ample space for entering the dates of birth of farm and other animals, while the rest of the volume is devoted to illustrated articles on different breeds of domesticated animals in 1908 and kindred subjects, most of these articles being by well-known specialists. Thus Shorthorns are discussed by the late Mr. John Thornton, while Mr. A. C. Beck treats of shire horses. Special interest attaches to an article by Sir Walter Gilbey on live stock a hundred years ago, where much information will be found with regard to the history and rise of many breeds.

Three out of the four papers in No. 3 of the seventh volume of the *American Journal of Anatomy* are devoted to the Mammalia (other than man), Dr. Henry Fox treating of the pharyngeal pouches and their derivatives, Mr. L. W. Williams describing the later development of the notochord, and Mr. W. A. Baetjer discussing the mesenteric sac and thoracic duct in pig-embryos. In the second of these the author finds that the primitive vertebra consists of undifferentiated mesenchyma, which never undergoes longitudinal segmentation, while the cartilage of the actual vertebra arises, not from a primary condensation of mesenchyma, but from a secondary condensation following a loosening of the dense tissue of the scleromere, or primitive vertebra. This secondary condensation of the vertebræ and intervertebral discs gives rise to pre-cartilage. At this time the notochord expands slightly in each vertebra, this being suppressed at the commencement of chondrification, when most of the notochordal tissue is forced into the intervertebral discs, where it forms the nucleus pulposus. Primarily cellular and epithelial, the notochordal tissue eventually becomes cellular, and then closely resembles cartilage.

The December number of the *Popular Science Monthly* is one of unusual interest to naturalists, as it contains the full text of Prof. W. Ridgeway's paper, read at the last meeting of the British Association, on the application of zoological laws to man; an article on the aspects of modern biology, by Prof. T. D. A. Cockerell; and one on the great Permian delta of Texas and its wonderful extinct vertebrate fauna, by Dr. E. C. Case. The remains of these animals are believed to have been carried down by the Permian rivers in flood-time and entombed in the mud of the delta. Restorations of several of the reptiles are given, and it is interesting to note that there appear to have been two distinct types of the "fin-backed" group, one of which (Dimetrodon) was carnivorous, while the other (Naosaurus) was probably omnivorous. The latter has perhaps the most wonderful dentition of any known animal, the incisor teeth being sharp and chisel-shaped, such as might be suited for cutting vegetable substances, while behind these are five pairs of sharp triangular cutting-teeth, these being followed by simple cones suited to holding a struggling victim. On the palate and the opposing portion of the lower jaw are heavy plates of bone covered by short, stumpy teeth of a type found in mollusc-eating fish. In the author's opinion, Naosaurus was probably omnivorous, but instead of possessing a dentition of a generalised type, like that of man or a pig, it had a special set of teeth for each kind of food.

The ichthyosaurs of the Trias, and more especially those of North America, form the subject of an elaborate monograph by Dr. J. C. Merriam, published as the first part of vol. i. of the Memoirs of the University of California. For several years past the author has been working at these reptiles, and in the present memoir we have the result of his labours. After a discussion of their distribution, the author proceeds to point out in what respects the Triassic representatives of the Ichthyopterygia differ from their successors of the Jurassic and Cretaceous epochs. These differences consist, for the most part, of less special adaptation to the exigencies of a purely aquatic mode of life, thereby bringing them into closer connection with less specialised land reptiles. What their terrestrial ancestor may have been is, however, still unknown; but it probably existed at least as early as the Lower Trias. By the middle portion of that period we find an undoubted aquatic form—Cymbospondylus—which retains, however, sufficient indications of affinity with a land form to give a clue to the origin of the group. This reptile, it may be presumed, had abandoned the shore as a regular dwelling-place, but still resorted thereto on occasion, and probably swam in shallow water in place of frequenting the open sea. In contrast to this we have the highly specialised representatives of Ophthalmosaurus and the closely allied, if not identical, Baptanodon, which were evidently adapted to play the part in the Jurassic oceans of the whales of the present day. Even these, however, display great simplicity of structure in all parts of their organisation except those specialised for swimming, and it is thus abundantly evident that the ichthyosaurs trace their ancestry to an extremely generalised type of reptile, while it is equally clear that the group is one of the oldest in its class.

The whole of the November issue (vol. liii., part i.), comprising 181 pages of text, is devoted to a paper by Prof. A. A. W. Hubrecht on the early ontogenetic phenomena in mammals, and their bearing on our interpretation of the phylogeny of the vertebrates, a paper to which it is impossible to do adequate justice in the space at our command. Naturally, the placenta and its modifications

loom very large in this communication, and it is noteworthy that the author regards the diffuse placenta, such as that of the lemuroids, as a specialised and simplified rather than a primitive type. The latter position, on the other hand, is claimed for the zonary placenta of the Carnivora, and it is noteworthy, in connection with the view that the creodonts are related to the mammal-like reptiles, that the author sees evidence of a placental relationship between marsupials, carnivores, and insectivores. Further, he expresses the belief (p. 132) "that the Didelphia furnish very conclusive evidence of their being very specialised descendants of placental mammals." This, of course, is in direct opposition to the views of Prof. J. P. Hill. As regards the Primates, the author is of opinion that they are widely sundered from the Lemuroidea, herein differing *in toto* from the recently expressed views of Messrs. Standing and Elliot Smith. It may be mentioned that Metachiromys, which the author still includes in the Primates, was regarded by Prof. H. F. Osborn in 1904 as an armadillo. The most startling part of the paper is, however, the proposal to divide vertebrates into the three groups of Cyclostomata, Chondrophora, and Osteophora, the first comprising the lampreys, the second the sharks and rays, and the third the whole of the remaining groups. A further suggestion is that the ganoid Polypterus, and perhaps also the lung-fishes, is the descendant of terrestrial tetrapodous ancestors, and the further suggestion is hazarded that a similar origin may be claimed for many teleostomous fishes.

THE announcement is made by the present editors of the *Botanische Zeitung* that at the close of this year they will withdraw from that office, and will, with the cooperation of Prof. L. Jost, start a new monthly journal, *Zeitschrift für Botanik*, to be published by the firm of Gustav Fischer in Jena. It is proposed to include original articles, reviews, and a summary of new literature in each part. Messrs. Gustav Fischer also announce that they are undertaking the publication of a new medical journal, *Zeitschrift für Immunitätsforschung und experimentelle Therapie*, that will consist of two parts, obtainable separately, the one devoted to original communications, the other to reviews.

PROF. W. TRELEASE has published a useful, although not fully determinate, note on the two species *Agave rigida*, Miller, and *Agave angustifolia*, Haworth. The first binomial has been applied by more than a dozen systematists to agaves of different kinds, but it appears that the original type named by Miller has to be rediscovered, and the author suggests a habitat between Venezuela and Yucatan. The discussion of *Agave angustifolia* leads to the view that this species includes *Agave lurida*, a common fence plant to-day in St. Helena, *Agave Wightii*, and other species that have received distinct appellations. The paper, with illustrations of the two species, is published in the nineteenth annual report of the Missouri Botanical Gardens.

IT is reported by Miss T. Tammes in the *Recueil des Travaux botaniques Néerlandais* (vol. v.) that in the species of Dipsacus a chromogen exists which on warming gives rise to a blue colouring matter; to the chromogen the name "dipsacan" is given, and the colouring matter is called "dipsacotin." The formation of dipsacotin is somewhat similar to the formation of indigo in the case of species of Indigofera. It is produced by the splitting up of dipsacan either by heating in the presence of moisture or by the action of benzin. Dipsacan occurs in all parts of the plant, especially in the growing region; it has been found in all genera of the Dipsacaceæ that have been examined, but is most abundant in species of Dipsacus.

THE quarterly issue of the *Trinidad Bulletin* (October) is an excellent number, containing much information, original and extracted, on the agricultural crops in Trinidad and adjacent islands. An article by Mr. A. W. Bartlett deals with cocoa-nut plantations and the preparation of copra. Mr. T. Thornton discusses the prospects for cotton cultivation in Tobago. Cotton of the "Marie Galante" type has been cultivated, but the Sea Island variety has not received much attention. Hints are provided on the propagation of cedar and cyp—*Cordia Gerascanthus*—seedlings for planting up areas; the latter requires more attention in the nursery, but will thrive on poor soil, and furnishes very good constructional timber.

APART from the information regarding trees and shrubs, the notes on Continental parks and gardens communicated by Mr. W. J. Bean to the *Kew Bulletin* (No. 9) will serve to direct attention to various horticultural and sylvestral localities that may with advantage be included in a Continental trip. At Tervueren, not far from Brussels, there is a comparatively new arboretum extending over 300 acres for the cultivation, in geographical groups, of such exotic trees as are sufficiently hardy. Within easy reach of Gouda are situated the nurseries of Boskoop, where the peaty soil provides an ideal home for rhododendrons, but where Japanese maples, wistarias, and many other valuable plants also luxuriate. The gardens at Herrenhausen and Sans Souci, the nurseries of Vilmorin at Verrières and Les Barres, of Lemoine at Nancy, of Späth near Berlin, and of Hesse at Weener, all famous horticultural centres, are briefly described.

DR. JURITZ discusses the underground waters of Cape Colony in recent issues of the *Agricultural Journal of the Cape of Good Hope*. He lays stress on the fact that an adequate water supply would completely alter the agricultural potentialities of the country, besides being of importance for all steam users, particularly railways, and then proceeds to set out a number of analyses of waters collected from different parts of the colony. The Table Mountain and Stormberg series were found to yield the purest waters, while the Uitenhage, Dwyka, and Bokkeveld formations gave rise to the most saline. Calcium chloride occurred in some cases, and sodium carbonate was found in the waters of the Middle and Upper Beaufort and Stormberg series, rendering the water quite unfit for agricultural purposes.

IN his "Vocabulary of Malaysian Basket-work," the late Dr. O. T. Mason, head curator of the anthropological department of the United States National Museum, made a notable advance towards a more scientific treatment of this important industry. Dr. W. L. Abbott has recently presented to the museum a large collection of baskets from Malaysia. This is now being studied in comparison with the extensive series obtained among the American Indian tribes and in the Philippines. To secure a scientific treatment of the subject it was found necessary to define accurately the terms applied to the various stages of technique and to the materials used in the processes of manufacture. Dr. Mason's glossary, all the more important articles of which are illustrated with excellent drawings, will do much to secure future accuracy of description and definition. Probably, for the present at least, his nomenclature will be accepted in describing the characteristics of the various groups of basketry among the lower races throughout the world.

The National Museum of the United States has made a new departure in the formation of series of exhibits to illustrate the main religions of the world, a scheme which had its origin at the Chicago Exhibition of 1891. In pursuance of this idea, collections have been made to illustrate the ceremonies of the various Christian Churches, Brahmanism, and Buddhism. We have now, under the editorship of Messrs. C. Adler and I. M. Casanovich, a catalogue of a collection of Jewish ceremonial objects which is of considerable interest. It seems to be an amplification of a similar catalogue issued in 1901, which was confined to a collection of articles lent for exhibition by Hadji Ephraem Benguiat. It contains accounts, with good illustrations, of many curious and beautiful objects with which few but members of the Jewish community are familiar. Particularly deserving of notice are the veils of the Holy Ark, which are fine examples of embroidery; the mantles and wrappers of the Torah scrolls; some graceful hanging lamps; phylacteries and amulets; vessels used in the Passover service; implements employed in ritual, sacrifice, and circumcision. The collection, besides its ritualistic and artistic importance, possesses considerable interest for anthropologists.

The publication of a new guide to the anthropological department at South Kensington, issued by the trustees of the British Museum, and sold at the modest price of 4*d*., throws an unpleasant light upon this series of exhibits. While the admirable new shilling guide to the Egyptian galleries occupies 325 pages, and contains 233 plates and other illustrations, thirty-one pages and sixteen photographs exhaust the anthropological series. Though not calculated to excite interest among those to whom the subject is unfamiliar, the guide, as might have been expected from the author, Mr. Lydekker, seems to be generally accurate. It is rather confusing, however, to divide the Dravidians of southern India into Telugus, Tamils, Malayalims, and so on, because these are linguistic, not ethnological, terms; and to speak of the first of these groups as if it were confined to the northern Circars is inaccurate. Possibly it is only from this corner of the tract occupied by the Telugu-speaking people that specimens are at present available. The inadequacy of the collections as they stand may be measured by the fact that while the attention of anthropologists has been in recent years attracted to the Pagan races of the Malay Peninsula by the great work of Mr. Skeat, they seem to be represented in the museum by a single photograph of a Sakai. When the Bureau of Ethnology gets to work these shortcomings in the national collection will doubtless be remedied; but in the meanwhile, Dr. Bowdler Sharpe is quite justified in remarking that in recent years the anthropological series has not increased so rapidly as is desirable, and in expressing a hope that the publication of this guide-book may stimulate public interest and induce British colonial officials and travellers to endeavour to supply the deficiencies in this important series.

The Survey Department, Egypt, has issued its Meteorological Report for 1906, consisting, as before, of two parts:—(1) hourly observations and means for Helwan Observatory, to which the records of a self-registering electrograph are now added; (2) climatological, rainfall, and river-gauge observations at a large number of stations, with a chronicle of the chief weather conditions of each month. Rainfall at the Egyptian stations was in slight defect, but over the Sudan plains the excess was about 22 per cent. The Nile presented several features of interest during the year; these have been discussed by Captain Lyons in a separate publication.

The *Annuario* of the Messina Observatory for 1907 has been received. We have previously directed attention to the useful work carried on by Prof. G. B. Rizzo and his small staff; meteorological observations made at several hours daily, with means and extremes, are given for the chief station, together with monthly and annual summaries for temperature, rainfall, &c., for a number of provincial stations. Particulars of earthquake phenomena registered at Messina and other places are also collected and discussed by Prof. Rizzo personally. In the year 1906 the director of the Potsdam magnetic observatory proposed to the Italian Government the establishment of a magnetic station in the south of Italy, as part of an international programme for the special study of that subject. For this purpose Messina has been selected as a suitable locality, thus making a useful addition to the study of terrestrial physics at the important observatory attached to the University of that city.

The *Neue Denkschriften* of the Swiss Society of Natural Sciences, vol. xlii., contains a useful discussion of the climate of Davos by Dr. Hugo Bach. Observations were commenced by the society in 1867, but are not quite continuous; the station is situated in a broad valley, at an altitude of 5118 feet, and owing to its surroundings the climate is of a much more continental type than is usual at ordinary mountain stations. The most important factor is the low pressure, corresponding to the altitude, as it affects to a considerable extent the conditions of radiation and temperature. The difference of absolute humidity between Davos and the lowlands is very great, especially during winter, and under these conditions the readings of the solar radiation thermometer on bright January days often record a temperature considerably above 100°, while the screen thermometer reads below 14° F.; this fact is naturally of very great importance to invalids. The absolute range of shade temperature between 1867 and 1905 is given as 110° F., the extreme readings being 84°·4, in July, 1900, and −25°·6, in January, 1905. The average percentage of possible sunshine is given as:—winter, 53·0; spring, 50·7; summer, 54·2; autumn, 56·1. The average annual rainfall amounts to nearly 36 inches; the wettest months are from June to September.

An account of the first portion of the work on the gas thermometer which has been in progress in the geophysical laboratory of the Carnegie Institution at Washington since 1904 under the charge of Messrs. Day and Clement appears in the November number of the *American Journal of Science*. The constant-volume nitrogen in platinum-iridium thermometer is used, and the range of the instrument has been increased by enclosing the bulb in a gas-tight bomb containing nitrogen at the same pressure as that in the bulb. The expansion of the material of the bulb was determined to within ½ per cent., and the unheated space between the bulb and manometer reduced to about one-third of its least previous value. The authors give the following melting points as accurate to within half a degree:—zinc, 418°·5; silver, 958°·3; gold, 1059°·3; copper, 1081°·0 C.

The important series of papers on fluorescence and phosphorescence which have appeared in the *Physical Review* during the last two years from the pens of Profs. Nicholls and Merritt have shown that the present theories of these and kindred phenomena are quite inadequate, and that Stokes's law that the wave-length of the light sent out by a fluorescent body was greater than that of the exciting radiation, is not correct. These facts have led Prof. de Kowalski to put forward in the October

number of the Bulletin of the Academy of Science of Cracow a theory which will at the least serve as a good working hypothesis. It is based on the corpuscular theory of matter, and assumes that amongst the systems of electrons which constitute the atoms and molecules, there are a number in a state such that a small increment of energy will render them unstable, and one or more electrons will be shot out of the system. These are in turn supposed to enter systems in which the electrons are capable of executing oscillations without becoming unstable. It is these electrons which give out the fluorescent light when the former systems are rendered unstable by the incidence of radiation on them. The author shows that this theory is in keeping with the known facts of fluorescence and phosphorescence.

MESSRS. LEITZ AND Co. have put on the market a universal projection apparatus designed in accordance with the suggestions of Prof. Kaiserling. We have examined this apparatus, and find it most complete. It is available for projection on the screen under a variety of conditions, viz. by transmitted light for both lantern and microscopical work, and by incident light for the projection of woodcuts and natural objects. The special feature of the design consists in the ease with which the change can be made from one mode of projection to another. For episcopic projection it is arranged that the object may either lie horizontally on the table or be in a vertical position. Thus, if it be desired to project on the screen part of a hospital patient, the subject is simply placed at the side so that the part in question may be illuminated by the lamp and completely reflected by the mirror. The electric lamp employed is one of the type which this firm is adapting to several purposes. The carbons are at right angles to one another, the positive one being horizontal and lying along the optic axis. With this arrangement the full crater becomes operative in producing useful light. The result is considerably greater efficiency, a power of 10,500 candles being obtainable with a current of 30 amperes. It is unnecessary to state that the optical part possesses the excellence of this firm's work. The lantern condenser is sufficiently large to illuminate a half-plate transparency, and the whole of it can be simultaneously projected on the screen. For microscopic projection both objectives and projection eye-pieces are quickly changed by revolving carriers. For the lower power objectives the entire field is in focus at once; it is only in the case of the difficult projection with 1/12th inch (oil immersion) that the peripheral regions are blurred. At present there is no polarising device, but this is under design. The entire apparatus stands inside a curtained frame, which prevents the escape of light into the room except through the lens. It stands on the floor, with the optic axis about 144 cm. from it.

HAZELL'S Annual for 1909 has been received. The volume includes much information of scientific interest, and is a valuable, concise record of progress in many departments of intellectual, industrial, and social activity.

MESSRS. SIEMENS BROTHERS AND CO., LTD., have issued a convenient self-opening pocket diary for 1909. In addition to the usual calendar notes and diary, the book contains useful tables and illustrations of various dynamos and other machines made by Messrs. Siemens.

IN an article in the Johns Hopkins Hospital Bulletin for November, Dr. Peyton Rous describes the course of physiological pathology which is given in the school of medicine of the University of Michigan. It extends over three hours a day during three weeks, and includes the pathology of vascular, cardiac, and respiratory disturbances.

THE fourth quarterly bulletin, for the year 1906–7, of the results obtained during the periodic cruises and in the intermediate periods, has been issued by the Conseil permanent international pour l'Exploration de la Mer. The bulletin deals with the following points:—condition of the atmosphere; the temperature and salinity of the surface water; the temperature, salinity, density, &c., of sea-water at different depths; oxygen, nitrogen, and carbon dioxide dissolved in sea-water; and plankton. The bulletin is published by Messrs. A. F. Høst and Son, of Copenhagen.

THE recent address delivered by Mr. Rudyard Kipling to the students of the medical school of the Middlesex Hospital, at the opening of the present session, has been published by Messrs. Macmillan and Co., Ltd., in the form of a booklet bound in limp cloth, at the price of 1s. net. The title of the little book is "Doctors," and, in addition to the address, the book contains as frontispiece a photograph of Mr. Kipling and a preface describing the work of the hospital, written by Mr. Reginald Lucas. We notice that the book is being sold for the benefit of the Middlesex Hospital.

THE 1909 number of "Whitaker's Almanac" is the forty-first annual issue. It is difficult to imagine what one would do without this indispensable book of reference, which has again increased in size and usefulness. Among new articles which have been included we notice those dealing with the navigation of the air and the radio-telegraphic convention, while the following interesting features will continue to appeal to students of science:—progress of astronomical science, the year's weather in the British Isles, the storms and floods of the year, and the earthquakes and volcanic eruptions, the year being in each case that ending on October 31, 1908.

OUR ASTRONOMICAL COLUMN.

MOREHOUSE'S COMET, 1908c.—A further discussion of the photographs of Morehouse's comet, taken at Juvisy, is published by M. Flammarion in the December number of the *Bulletin de la Société astronomique de France* (p. 513).

M. Flammarion reproduces further photographs, and shows that, while the main features of the tail are explicable by the Maxwell-Bartoli laws of light-pressure demonstrated experimentally by Lebedew, there are other features which point distinctly to the operation of other causes. For example, the photograph of October 15 shows the now well-known dislocation of the tail, at some distance from the head, which might be due to the interference of meteoritic matter. On the photograph of October 17, however, there is no definite dislocation, although there is distinct evidence that the tail, as a whole, suffered some retardation in respect to the motion of the nucleus. Several possible explanations are offered, with full reserve, for this phenomenon. One is that the æther may have a density which is not homogeneous; another is that the sun is constantly repelling matter into interplanetary space, and that this matter would retard the masses of tenuous vapours forming the tail of the comet. A third explanation is that most generally accepted, viz. that the retardations and dislocations are probably caused by the interference of masses of meteorites with which space is probably peopled.

A note in the same journal (p. 534) announces that MM. le Comte de la Baume Pluvinel and Baldet have, since the publication of their preliminary paper in the *Comptes rendus*, obtained many more photographs of the

spectrum of the comet, including some taken with a calcite-quartz spectrograph, which show new radiations and will enable better wave-length values to be determined; the conclusions published in the first note are to be looked upon as only provisional.

OBSERVATIONS OF THE SURFACES OF JUPITER'S PRINCIPAL SATELLITES AND OF TITAN.—During the 1907–8 opposition of Jupiter, M. J. Comas Solá continued his observations of the principal Jovian satellites, and now publishes his results, with drawings of J iii. and iv., in No. 4290 of the *Astronomische Nachrichten* (p. 290, December 11).

Satellite i. appears to be definitely ellipsoidal, the flattening amounting to as much as one-fifth of the major axis. The direction of the longest axis is not, according to M. Solá's observations, parallel to that of Jupiter's bands, but has a position-angle some 28° greater than that of the bands.

With most other observers, M. Solá finds that the second satellite always appears round.

The observations of J iii. are given in detail, and many features on the satellite's surface noted. Among these, white polar caps, varying in intensity and size from time to time, equatorial bands, and shadowy areas were observed, and, from the varying appearance of the latter, it would appear that the effects of the satellite's rotation were seen.

Satellite iv. presented no feature which could be seen definitely, with the exception of a very faint north polar cap on December 24, 1907, but several were suspected from time to time.

The observations of Titan indicate that this member of the Saturnian family has a more or less dense atmosphere, for the limbs were always dark and difficult to see, whilst towards the centre of the disc lighter patches were visible. The drawing for August 13, 1907, shows two of these patches having the appearance of a very diffuse double star.

CORRECTIONS OF THE POSITION AND DIAMETER OF MERCURY.—From observations of the contacts during the transit of Mercury on November 13–14, 1907, Prof. Stroobant has deduced corrections for the position and diameter of the planet, and publishes the results in part i., vol. xii., of the *Annales astronomiques de l'Observatoire royal de Belgique*.

The observations were made at thirty-three observatories in different localities in Europe, South Africa, and the United States, and their discussion leads to the following results:—Instead of the diameter being 6″·61, at unit distance, as usually accepted, it is 6″·16, and, consequently, the actual radius, taking the equatorial radius of the earth as 6378 km., is 2232 km. From this it follows that, as compared with that of the earth, the volume of Mercury is 0·043 instead of 0·052, whilst the density is 1·42 instead of 1·17, if the accepted value for the mass be retained. The corrections to the position of the planet in the equatorial coordinates are $\Delta\alpha = +0\cdot066$s. and $\Delta\delta = \;\; 0''\cdot22$, and in the ecliptic coordinates $+0''\cdot07$ and $+0''\cdot04$ in longitude and latitude respectively.

THE SOUTH POLAR CAP OF MARS.—Bulletin No. 35 of the Lowell Observatory contains Prof. Lowell's measures, made from drawings, of the size of the south polar cap of Mars between March 22 and November 13, 1907.

The tabulated results give the history of the cap for about eight of our months, from about its maximum to near its minimum area, and show that its size decreased regularly from about 0·388 of a hemisphere to 0·002.

THE "COMPANION TO THE OBSERVATORY."—This useful annual, published by Messrs. Taylor and Francis at 1*s.* 6*d.*, contains the usual data and ephemerides for the observations of the sun, planets, eclipses, satellites, variable and double stars, &c.

Mr. Denning has revised the meteor notes, Mr. Maw has supplied a number of observations of double stars, and M. Baillaud has furnished advance proofs of the *Annuaire du Bureau des Longitudes* from which the list of Algol variables has been copied.

A useful list of the standard times of various countries using the Greenwich meridian is given on p. 32, and from the table of the magnetic elements for Greenwich Observatory we see that the "inferred" values for 1909 are:—declination, 15° 50′ W.; horizontal force, 0·1854; dip, 66° 55′.

THE NIZAMIAH OBSERVATORY AT HAIDARABAD.—The establishment by his Highness the Nizam of Haidarabad of a well-equipped astronomical observatory in his dominions is referred to in the *Times* of December 17. The equipment includes, besides the purely astronomical and meteorological instruments, a very complete photographic department and extensive workshops fitted with modern tools and appliances for both wood and metal working.

PRIZE SUBJECTS PROPOSED BY THE FRENCH ACADEMY OF SCIENCES FOR THE YEAR 1910.

GEOMETRY.—The grand prize of the mathematical sciences (3000 francs). The problem of finding all the systems of two meromorphic functions in the plane of a complex variable and connected by an algebraic relation is known. The analogous question is suggested for a system of three uniform functions of two complex variables, having everywhere at a finite distance the character of a rational function and connected by an algebraic relation. In default of a complete solution of the problem, to indicate examples leading to classes of new transcendental functions. The Francœur prize (1000 francs), for work in pure or applied mathematics; the Poncelet prize (2000 francs), for a work on pure mathematics.

Mechanics.—A Montyon prize (700 francs), for inventing or improving instruments useful to the progress of agriculture, the mechanical arts, or sciences; the Fourneyron prize (1000 francs), for an experimental and theoretical study of the effects of shocks of a hydraulic ram in elastic tubes.

Navigation.—The extraordinary prize of 6000 francs, for work tending to increase the efficiency of the French naval forces; the Plumey prize (4000 francs), for improvements in steam engines or any other invention contributing to the progress of steam navigation.

Astronomy.—Pierre Guzman prize (100,000 francs), for the discovery of a means of communicating with any planet other than Mars, or, failing this, the interest will be awarded for work leading to progress in astronomy; the Lalande prize (540 francs); the Valz prize (460 francs); the Janssen prize, for an important progress in astronomical physics.

Geography.—The Tchihatchef prize (3000 francs), for Asiatic exploration; the Binoux prize (2000 francs), for work on geography or navigation; the Delalande-Guérineau prize (1000 francs); the Gay prize (1500 francs), for zoological and anthropological researches in South America, especially in the region of the Andes.

Physics.—The Hébert prize (1000 francs), for a discovery in electricity of practical or industrial use; the Hughes prize (2500 francs); the Kastner-Boursault prize (2000 francs), for the best work on the application of electricity in the arts, industry, or commerce.

Chemistry.—The Jecker prize (10,000 francs), for work in organic chemistry; the Cahours prize (3000 francs), for the encouragement of young chemists; Montyon prizes (unhealthy trades) (2500 francs and a mention of 1500 francs), for improving the hygienic conditions of an unhealthy trade or calling; the Berthelot prize (500 francs); the Alhumbert prize (1000 francs), for an experimental study of the electrical properties of the metallic alloys.

Mineralogy and Geology.—The Delesse prize (1400 francs).

Botany.—The Desmazières prize (1600 francs), for a memoir on cryptogams; the Montagne prize (1500 francs), for work on the anatomy, physiology, development, or description of the lower cryptogams; the de Coincy prize (900 francs), for a work on phanerogams; the de la Fons-Melicocq prize (900 francs), for a work dealing with the botany of the north of France; the Bordin prize (3000 francs), for a study of the origin, development, and disappearance of the transitory tissues which may enter at various periods into the structure of the vascular plant.

To determine, in each particular case, the ephemeral *rôle* of the tissue considered.

Anatomy and Zoology.—The Savigny prize (1500 francs), for the assistance of young travelling zoologists, not in receipt of Government assistance, and who specially occupy themselves with the invertebrate animals of Egypt and Syria; the Thore prize (200 francs), for the best work on the habits and anatomy of one species of European insect.

Medicine and Surgery.—A Montyon prize (2500 francs and mentions of 1500 francs), for a discovery useful in medicine; the Barbier prize (2000 francs), for a discovery of value to medical, surgical or pharmaceutical science, or botany in relation to medicine; the Bréant prize (100,000 francs), for the discovery of a cure for Asiatic cholera or the definite cause of this disease. If the prize is not awarded, the interest will be given for researches bearing on cholera or other epidemic disease. The Godard prize (1000 francs), for the best memoir on the anatomy, physiology, and pathology of the urinogenitary organs; the Baron Larrey prize (750 francs), for a work treating of military medicine, surgery, or hygiene; the Bellion prize (1400 francs); the Mège prize (10,000 francs); the Dusgate prize (2500 francs), for the best memoir on the diagnostic signs of death and on the best means of preventing premature burial.

Physiology.—A Montyon prize (750 francs), for a work on experimental physiology; the Philipeaux prize (900 francs), for the same; the Lallemand prize (1800 francs), for works relating to the nervous system; the Martin-Damourette prize (1400 francs), for a work on therapeutical physiology; the Pourat prize (1000 francs), for a memoir on the action exercised by the X-rays and the radium rays on the development and nutrition of living cells.

Statistics.—A Montyon prize (1000 francs, and a mention of 500 francs), for the most useful work dealing with statistics.

History of Science.—The Binoux prize (2000 francs).

General Prizes.—These include the Arago, Lavoisier, and Berthelot medals; the Gegner prize (3800 francs); the Lannelongue prize (2000 francs); the Trémont prize (1100 francs); the Wilde prizes (one of 4000 francs and two of 2000 francs), for discoveries in astronomy, physics, chemistry, mineralogy, geology, or experimental mechanics; the Lonchampt prize (4000 francs); the Saintour prize (3000 francs); the Victor Raulin prize (1500 francs), for a work on the meteorology and physics of the globe; the prize founded by Mme. la Marquise de Laplace; the Félix Rivot prize (2500 francs); the Leconte prize (50,000 francs), for important discoveries in mathematics, physics, chemistry, natural history, or medicine; the Houllevigue prize (5000 francs); the Caméré prize (4000 francs); the Jérome Ponti prize (3500 francs).

Of these, the Pierre Guzman, Lalande, Tchihatchef, Delesse, Desmazières, and Leconte prizes are expressly stated to be offered with preference of nationality.

CHEMICAL RESEARCH AT THE UNIVERSITY OF MANCHESTER.

THE chemical schools at the University of Manchester, probably already the largest in the kingdom, are being enlarged by the addition of a new block of buildings at a cost of about 20,000*l*. Already considerable progress has been made with the building operations, and it is hoped that the new block will be ready for opening in the early autumn of 1909. The chief addition will be a new large laboratory having accommodation for forty students, and fifteen smaller research laboratories.

The following description of the objects of the new buildings is taken from a recent interview with Prof. W. H. Perkin, published in the *Manchester Guardian*. He considers that the loss of the coal-tar industry to this country was due, not only to the manufacturers not realising the importance of employing chemists and carrying out research work, but also to the universities, which were very greatly to blame. Organic chemistry was hardly taught at our universities, and such laboratories as they possessed were poor and ill-equipped. As a consequence, if manufacturers did require chemists they could not obtain them. It was in 1874 that the original coal-tar colour works at Greenford Green, near Harrow, were sold. The reason for giving up the works was partly owing to the natural dislike for an industrial career of the late Sir William Perkin and his desire to devote himself entirely to research chemistry; but it was also because he recognised that the works could not be satisfactorily carried on and be able to compete successfully with the rising industry in Germany unless he took into the works a large number of research chemists, as the Germans had done. But although inquiries were made at many of the British universities in the hope of finding young men trained in methods of organic chemistry, such men were not forthcoming.

The older universities at that time scarcely recognised organic chemistry; it is doubtful whether they thoroughly appreciated chemistry at all. The newer universities, which at present are doing such good work and of which we are justly proud, had not come into existence. Prof. Perkin said he was strongly of the opinion that the manufacturer of organic products during 1870–1880 was, owing to this neglect of organic chemistry by our universities, placed in a very difficult and practically impossible position.

But, in the meantime, organic chemistry had taken root in Germany, and great schools devoted to this branch of chemical science had been founded. History tells us how the German manufacturers made use of the young chemists who had been trained in these laboratories. Consequently, the works in Germany increased in size and in number, and obtained the world's trade in organic chemicals. Had our universities at this time pursued the same principle, in all probability the coal-tar colour and allied industries would not have been lost; but now this state of things has changed, and "I am convinced that failure on the part of the manufacturers to develop any industry connected with organic chemistry is no longer due to the impossibility of obtaining the services of young chemists of ability."

The scheme which it is hoped to develop in connection with the Manchester Chemical School is laid on the lines which have been found so valuable abroad. Two lines of procedure are open to the manufacturer.

He may send his sons to the university, and as soon as they have passed through the honours B.Sc. course, and have thus received a thoroughly sound general training, they will be fit to engage in research work dealing with problems of a technical nature, either suggested by the university professors or by the manufacturers. Such a course, extending over two or more years, will be the best preparation for an industrial career.

Another way in which the manufacturers can be helped if they wish to solve a difficult problem or invent some new process is to place at their disposal one of the smaller research rooms. In this room his own research chemist from the works can, under the best conditions, investigate the problem, either alone or with assistance from the university staff. If he happens to have no research chemist available for the purpose, one of the university graduates can be engaged to work under the professor's superintendence.

The University will, however, not open its doors to do purely routine analysis, ordinary commercial work, or patent litigation. It lays itself out to train research chemists or help by research work, and in this direction alone.

WATERS AND GLACIERS.

UNDERGROUND waters play a considerable part in recent researches on French caves (*Spelunca*, tome vii., 1907–8, Nos. 47–52). M. Fournier's observations in the Jura (Nos. 47 and 50) are largely concerned with following out the courses of streams that are used for household purposes. He agrees with M. Martel that springs may be regarded with suspicion when their temperature varies by even 1° C. from that of water in the same region which is known to come from considerable depths. A number of caves in various levels of Jurassic limestone are drawn in plan and section, and the continuity of certain streams has been proved by the use

of fluorescein. As an example of the practical results of such researches, it may be mentioned that the village of Mouchard, on the west flank of the range, was found to be utilising an already contaminated water, which ran away out of the public fountain and reappeared as the main supply of Pagnoz, a hamlet on the Salins road. The author complains that it is hard to move local authorities; but, if Mouchard now becomes grateful, Pagnoz may be doubly so. Messrs. Albert and Alexandre Mary (No. 48) describe the artificial excavations in the chalk at Saint-Martin, Oise, and urge that the movement of water in chalk is controlled by fissures, which are in some cases fault-planes, and not by a general porosity of the rock. Where the chalk is fractured on a small scale, as in the Upper Senonian, owing to the yielding character of a particular series of beds, the water flows along the abundant and delicate crevices; where, however, there are only coarser joints, these become the prominent and effective water-ways (p. 13). The caverns in Oise may have been dug out by man as hiding places, but the fissures selected had previously been widened by natural waters. About the twelfth century they became used as quarries. This memoir by MM. Mary concludes with an account of the modifications that took place in certain plants removed by the authors from the outer air to the banks of one of the subterranean lakes. M. Ed. Rahir (No. 51) reports on caves in the Carboniferous Limestone of Belgium; and M. Paul Macey (No. 52) carries us away to Indo-China, and gives a spirited account of rivers that penetrate masses of limestone in the province of Cammon, of which he is Governor. His zeal for exploration is not more commendable than his regard for the religious feelings of his subjects. We wonder if all British cave-hunters would have sacrificed a pig and a few fowls before descending a haunted river in a collapsible bamboo canoe. The cheerful description of two days underground on this unknown water-way should satisfy even M. Martel, to whom it is presented. The tunnel of the Nam Hin-Boun, 4000 metres long, is, on the other hand, used as a highway by the natives themselves when the river is low. The basin of Hang Nam-Thieng (vessel of holy water) reminds us of the miraculous stoup attached to an old church in Anglesey; it is about 15 centimetres in diameter, and re-fills itself up to a certain level after water is drawn from it. The French have again allowed the use of its water in ceremonial oaths, according to a practice that had fallen into disuse since the Siamese invasion of 1827.

The production of valleys and deltas has been studied artificially by Mr. T. A. Jaggar, jun. ("Experiments illustrating Erosion and Sedimentation," Bull. Museum of Comp. Zoology, Harvard, vol. xlix., 1908, p. 285). Various rock-powders are strewn over one another in layers, or slimes from a stamp-mill are deposited from water. The surface is then tilted at 20° and is subjected to a water-spray, furnished by a compression apparatus and an atomiser such as barbers use. Rill-systems arise on the slime-surface after one or two hours, and illustrations of river-capture (p. 290) occur among their details.

Mr. E. F. Pittman, Government geologist of New South Wales, in his Clark memorial lecture (Geol. Survey of New South Wales, Sydney, 1908), has reviewed the very important question of the artesian water-supply of Australia. He sees many reasons for opposing the view of Prof. J. W. Gregory, who has maintained that the water rises from plutonic depths under the influence of earth-pressure, and not as the result of hydrostatic flow in an artesian basin. Mr. Pittman believes that the rainfall on the exposed edges of the sandstones in the Great Dividing Range in south-eastern Queensland and in the north of New South Wales is sufficient to account for the water stored in the artesian area. He agrees with Prof. J. W. Gregory in deprecating the waste of this water that is at present tolerated. In a coloured map he indicates the enormous area of the main basin, extending from the central part of the Darling River through Queensland to Cape York.

Passing to the solid form of water, the *Actes de la Société helvétique des Sciences naturelles*, for the ninetieth session at Fribourg, in 1907, contains much that is interesting in the study of glaciers. Prof. Mühlberg, of Aarau, reviews (p. 91) the state of Switzerland during the Ice age, which he properly regards as a world-wide phenomenon. He suggests (p. 94) that certain moraines in Alsace were recognised as the deposits of former glaciers so far back as the middle of the eighteenth century; but all that he really proves is that these ridges were called moraines by settlers from Switzerland. De Saussure tells us that this term, variously spelt in his day, originated in Savoy, where it was applied to any steeply sloping piece of hillside. Jean-Pierre Perraudin, the chamois-hunter of the Val de Bagne, seems still to hold his own as the first to realise that the Swiss glaciers were formerly of far greater extent. Prof. Jean Brunhes, curiously enough, emphasises the observations of Perraudin on glacial striæ in a paper on "Le Problème de l'Érosion et du Surcreusement glaciaire" (*ibid.*, p. 155). Prof. Brunhes seeks to show that there is little real distinction between geographical features that are claimed as of glacial origin and those produced by rivers. A main stream, he urges (p. 164), will cut down its bed below those of its tributaries, though the difference of level will diminish as the river-system grows older. We hardly follow him when he sees the U-form, commonly held to result from glacial action, repeated in the floor of the Colorado canyon; but he points out very usefully that the streams under the ice near each margin of a glacier often produce two parallel *surcreusements* of the valley-floor, with a glaciated rock-ridge between them (p. 166). This common phenomenon, which he illustrates by photographs, is very different from the trough-like form which the advocates of glacial erosion attribute to rapidly moving ice. While Prof. Brunhes believes that the subglacial water is the main agent in lowering the valley-floor, he shows how abrasion by ice may ultimately remove the central rib which characterises earlier stages of erosion. The two agents must be regarded as working together, and not in succession to one another, if we would correctly appreciate valley-forms.

The twelfth report of the Commission internationale des Glaciers, in which variations of glaciers are recorded from all parts of the world, appears in the second volume of the *Annales de Glaciologie* (1908), pp. 161–198. An abstract of this, by M. Forel, has been already reviewed in NATURE by Prof. Bonney (vol. lxxviii., p. 574). In *Naturen*, published in Bergen, vol. xxxii. (1908), p. 118, Herr J. Rekstad records both recessions and advances among Norwegian glaciers between 1900 and 1907. The cold summers of 1902, 1903, and 1904 are responsible for many advances and thickenings in the lower parts of the ice-streams, and the full results of that of 1907 have yet to manifest themselves.

Mr. H. H. Hayden's "Notes on Certain Glaciers in North-west Kashmir" (Records, Geol. Survey of India, vol. xxxv., 1907, part iii., p. 127) records the establishment of stations by which rates of movement may be determined. The Yengutsa Glacier has advanced about two miles since 1902, and has overwhelmed mills that then existed in a stream-cut stretching from its foot. The Hassanabad Glacier, on the evidence of competent native officials, advanced "about three years ago" six miles or more in two and a half months. It seems liable to extraordinarily rapid fluctuations, and is now said to be stationary. Clearly, accurate records will be of special interest in this case. Other glaciers in Kashmir show "steady secular retreat." One would like to learn if the local advances can be traced to exceptional snowfalls, or even to earthquakes, as in recent instances in Alaska. The great attraction of Mr. Hayden's paper lies in the superb photographic plates by which it is illustrated. That of the Hassanabad Glacier lying in its ravine is especially successful.

In the Bulletin of the American Geographical Society, vol. xxxix., March, 1907, Messrs. Tarr and Martin comment on Prof. Russell's conclusion that the Hubbard Glacier of Alaska has receded five miles since 1794. From their personal experiences in 1906, they hold that Malaspina's remarks on ice as an obstacle in the bay referred only to floating ice, and this seems confirmed by the evidence of the vegetation and by the occurrence of wave-cut shore-lines in the region which, according to Russell, would have been covered a century ago by glacier-ice.

Perhaps we may include in this notice Messrs.

Sheppard and Stather's account of a fine section made in England by the North-Eastern Railway Company in the glacial gravels of Holderness (Proc. Yorkshire Geol. Soc., vol. xvi., 1907, p. 171). A few molluscan species from the drifts are added by the authors to those already known; but the main interest lies in the bones of mammoth, bison, horse, walrus, &c., which are believed to have been pushed up inland from the beach by the encroaching ice-front. G. A. J. C.

THE TRANSVAAL AND INDIAN DEPARTMENTS OF AGRICULTURE.[1]

(1) THE annual report of the Transvaal Department of Agriculture recently to hand gives a vast amount of interesting information about the department and the work it is doing among the agricultural community of the Transvaal. The agricultural conditions at the time of its formation were about as bad as it was possible for them to be. Animal diseases were rife, and besides the ordinary diseases of the country a number of new ones had been introduced during the war. The harvests had been neglected, consequently there was a shortage of seed corn; indeed, some varieties were almost, if not quite, lost. The land was in the bad state into which it rapidly falls when neglected, and out of which it can only be brought by dint of much skilful labour. Only a strong agricultural department could have met the necessities of the case; a weak one might easily have done a great amount of harm.

The occasion was one when the ordinary British instinct would have been to send out a number of "practical" men to devise "practical" measures for coping with the various problems. Fortunately, the British instinct did not prevail; the various heads of departments were men of scientific training, who began by making a study on scientific lines of the conditions with which they had to deal. As might have been expected, the result has been eminently satisfactory. The Public Service Commission declared itself unable to suggest any alterations or improvements in the general plan, and even the commissioner who was appointed to go into the detailed workings only made a few minor alterations in the clerical staff; amid much retrenchment in other directions this department has been left practically untouched. To the director, Mr. F. B. Smith, belongs the credit of having boldly conceived the plan and vigorously executed it; to the scientific staff belongs the credit of having risen to the occasion, and, in the words of one of the Transvaal newspapers, "triumphantly vindicated the practical value of research work."

It is just this "triumphant" vindication that gives the department a world-wide, and not merely a local, importance. No one can read the report and the other publications of the department without being impressed with "the practical value of research work." The investigations of Dr. A. Theiler, of the veterinary bacteriological laboratory, afford admirable cases in point. A number of the animal diseases with which the country abounds have been studied; in many cases the particular organisms causing the diseases have been identified, and the method by which they are conveyed from animal to animal discovered. The knowledge thus gained has made it possible to devise means for controlling the disease. This year's experiments have dealt more particularly with *Piroplasma mutans*, an organism that had previously been confounded with the *Piroplasma bigeminum* producing a South African redwater, and it is shown that the disease, sometimes contracted even after inoculation, and thought to be ordinary redwater, is really brought on by the newly discovered Piroplasma. "Horse sickness" and "biliary fever" in horses have also been investigated, and inoculation against the latter disease can now be satisfactorily performed, as also can inoculation against "blue tongue" in sheep. Great as is the immediate value of this kind of work, its future value is even greater; the Transvaal is essentially a stock-producing country, but stock cannot be raised in number until the diseases are more under control.

In the botanical section Mr. Burtt-Davy has been examining the native flora and more closely studying promising plants; the habits of troublesome weeds have also been investigated, and methods devised for their eradication. Satisfactory progress is also reported by the plant pathologist, Mr. Pole Evans. During the year 300 different kinds of fungi and plant diseases were dealt with, a large proportion of the latter being previously undescribed. Attention this year has been largely directed to bitter-pit in apples, a disease causing enormous loss to apple growers, on which a full report is promised at a later stage. Rusts affecting cereals and other economic Gramineæ have also been studied, and the "South African locust fungus" has been shown in its true light. Locusts are sometimes fatally attacked by a fungus, *Empusa Grylli*, Fres., and the Cape and Natal Governments cultivated and distributed what they thought was the fungus with the view of exterminating locusts. Mr. Pole Evans, however, found that the cultures were not Empusa at all; in fact, Empusa is a pure parasite which cannot be cultivated on artificial media, and is therefore of no practical value as an exterminating agent. On following the matter up, he found that Empusa had been the starting point in the Cape cultures, but the harmless *Mucor exitiosus* had appeared, and had been propagated and widely distributed under the impression that it was a destructive organism!

The working of the other sections—entomological, forestry, chemical, &c.—appears to be on equally sound lines, while the experimental farms have appealed strongly to the Boer farmer. At the Rand Agricultural Show the department's farms were very successful, both in the competitions and in their other exhibits.

Altogether the working of the department reflects great credit on all concerned, and affords abundant illustration of what science can do for agriculture.

(2) The history of the foundation of Pusa, the Indian agricultural experiment station, is too well known to need repetition here. The recently issued report shows the results already obtained, and indicates the broad lines on which work is to proceed; progress has been steady, and the character of the work promises well for the future of Indian agriculture.

Naturally we can only look for preliminary results at the present stage. Work at Pusa has hitherto gone on under a certain amount of difficulty. The buildings have not long been completed. The staff have had very little assistance; experienced natives to supervise field experiments and to give other help were not at first obtainable, and have had to be trained up. Some of the experimental plots were ruined by sudden floods, to which the estate is liable, owing to heavy, continuous rain. All this makes research work difficult, and the staff deserve high credit for having accomplished so much in these rather unfavourable circumstances.

Considerable attention has been devoted to the study of crops suited to Indian conditions—cotton, sugar-cane, jute, flax, tobacco, wheat, &c. The possibility of extending cotton cultivation in India is being carefully investigated, certain grants being made for the purpose by the British Cotton-growing Association; so far, the most hopeful line of development seems to be to make the best of the indigenous varieties rather than to introduce new and finer varieties. Serious attempts are also being made to strengthen the position of the indigo planter, and, in addition to the work being done by Mr. Bergtheil, a botanist has been engaged by the Planters' Association to improve the indigo plant by selection and breeding. The Indian wheats are being collected by Mr. Howard, and type-specimens separated from the mixed crop usually grown; these are described in a monograph, which will be awaited with considerable interest. Similar work on the native barleys and tobaccos is in hand. In all these cases cross-breeding, selection, and distribution of varieties true to type will follow.

The chemical department has, up to the present, been

[1] (1) Annual Report of the Transvaal Department of Agriculture, 1906–7 (received September, 1908). *The Transvaal Agricultural Journal*, vol. vi., 1908.
(2) Report of the Imperial Department of Agriculture for the Years 1905–6 and 1906–7. (Received October, 1908.)
The Agricultural Journal of India, vol. iii., 1908.
Memoirs of the Department of Agriculture in India.

largely occupied with miscellaneous analytical work, but chemists are now being appointed to each province, and Dr. Leather will be left free for research work. A pot-culture house has been built, and drain gauges made.

As might be expected, the mycologist, Dr. Butler, has a very large number of plant diseases to deal with, and the essential preliminary inquiries have been hampered by want of assistants and of a reference herbarium; these difficulties are being steadily overcome.

Mr. Maxwell Lefroy has already rendered considerable service to Indian agriculture by his entomological work; the life-histories of injurious insects are under investigation, and the insecticidal methods suggested have reached the stage of field trials.

The department issues two publications:—(1) the Agricultural Journal of India, a quarterly journal intended for the use of educated Indian agriculturists and general readers interested in agriculture; (2) the Scientific Memoirs of the Department of Agriculture in India.

The former must certainly rank among the most attractive agricultural journals published, if only for its beautifully illustrated descriptions of native husbandry; it also contains accounts, written for the practical man, of the experimental work done at Pusa and elsewhere. The Memoirs are the scientific papers by the members of the Pusa staff; they are widely distributed, and are readily obtainable on application. The system of publishing scientific work in this way has obvious disadvantages, but is said to involve less loss of time than if the papers were sent to a home journal. In most cases purely Indian problems are dealt with: we need only mention the Indian cottons (Gammie), Indian wheat rusts (Butler and Hayman), the composition of Indian rain and dew (Leather), of Indian oil seeds (Leather), Lefroy's papers on the tobacco caterpillar, the castor semi-looper, the rice-bug, and others. This is as it should be; general fundamental problems are best worked out here or in Europe or America, where the number of workers is greater and where it is easy to get into touch with those able to render useful assistance.

E. J. RUSSELL.

WHO BUILT THE BRITISH STONE CIRCLES?[1]

STONE circles are prehistoric monuments of a kind which must be familiar to everybody who has seen Stonehenge or any of the other numerous examples to be found in the British Isles. They are to be found chiefly in Great Britain. I believe there are few, if any, examples in Ireland; but a complete chart showing the distribution of stone circles has yet to be made.

The genuine stone circle apparently occurs only in the British Isles. Most, if not all, of the circles found in other countries are merely "retaining walls" left after the tumulus which they retained had been removed. Avenues and dolmens, which are found associated with stone circles in Britain, also occur in other countries. The dolmens especially are widely distributed, generally near the sea coast of the Mediterranean, in the west of France, in the north of Germany, in Denmark and Scandinavia, and in the British Isles.

It would appear, therefore, that the stone circle was an improvement on the dolmen and avenue, not introduced from abroad, but invented in the British Isles.

The stone circles of Britain vary somewhat in the details of their structure. Mr. Lewis divides them into three classes:—

(1) The Dartmoor type, which is found mostly in Cornwall and Devon, and consists of a single circle.

(2) The Aberdeenshire type, of which the distinguishing feature is the large recumbent stone placed between two of the upright stones in the southern part of the circle.

(3) The Inverness type, of which the distinguishing feature is a large domed chamber with an alley leading thereto, covered by a cairn, with entrances towards the south. When the cairn is removed the foundations show three concentric circles.

[1] Paper by Mr. J. Gray read before Section H of the British Association at the Dublin meeting, September, 1908.

These modifications appear to be due to idiosyncrasies of different tribes of the same race. The type is simplest in Devon and Cornwall, and increases in complexity and elaboration in the Aberdeen and Inverness types.

The Distribution of Stone Circles in Britain.

Stone circles do not appear to occur in the eastern counties of England, nor in the north-western counties of the mainland of Scotland. They are found in the greatest number in Cornwall, Devon, South Wales, Shropshire, North Wales, Derbyshire, Cumberland, Wigton, Kirkcudbright, and Dumfries, Arran, Perth, Aberdeenshire, Inverness, Orkney, and Lewis.

Their distribution would be simply explained if we assume that the race who built them first settled in Cornwall and Devon, then migrated up through Wales and Lancashire into south-west Scotland. From thence they passed north to the mouth of the Clyde, crossed through the midlands of Scotland to the mouth of the Tay, whence they moved along the east coast through east Aberdeenshire, then west to Inverness, and after that north through Caithness to the Orkney Isles, the migration finally coming to an end in the Isle of Lewis.

That the direction of the migration was from south to north is supported by the fact that the structure of the circle becomes more elaborate as we move northwards.

Associated Place-names.

If these stone circles in Britain have all been erected by the same race, one would expect to find some common root in the oldest place-names within the stone-circle area. The river names usually are the oldest place-names, and in Britain, at least, they appear to be derived from the names of tribes, who at some very ancient time settled on their banks. According to Ptolemy's geography, the district now covered by Cornwall and Devon was inhabited during the Roman occupation by a tribe called the *Dumnoni*. There can be little doubt that this tribal name, by a process of phonetic decay, has been transformed into the modern name of *Devon*. If confirmation be required of this, it may be pointed out that a tribe also named *Dumnoni* is mentioned by Ptolemy as occupying the midlands of Scotland, and that they have left the same phonetic transformation of their name in the River Devon, a tributary of the Forth flowing through Perth, Kinross, and Clackmannan.

There are four rivers Dee within the stone-circle area and none outside. Now it is clear from Ptolemy's geography that the primitive form of *Dee* was *Deva*, so that Dee is from the same root as Devon. The following is a list of names of rivers within the stone-circle area, which apparently are phonetic modifications of the same root:—Tamar, Taw, Severn, Taff, Teifi, Dovey, Dee (North Wales), Dove, Tame, Dee (affluent of Lune), Devon (Perth), Tay (ancient Tavus), Dee (Aberdeen), Deveron.

There are only very few of these river names outside the circle area, as Thames, Teviot, Tweed.

The stone-circle race from Cornwall to Aberdeen appears to have had one common tribal name, "Devonian," or some phonetic equivalent of that name. No doubt they had other tribal names, but I do not propose to venture further in this direction at present.

Anatomical Characters of the Race with which Stone Circles are Associated.

I consider that a far more trustworthy guide than philology to the affinities and origin of a race is to be found in the analysis of measurements of its anatomical characters. This assumes, of course, that the average physical characters of a race will remain practically identical for vast periods of time if there is no great change in the racial environment. For example, the dimensions of the pre-dynastic Nagada skulls (measured by Miss Fawcett) have been found to be practically the same as those of the modern Egyptians living in the same district (measured by Dr. C. S. Myers). This means a permanency of average dimensions extending over 8000 to 10,000 years.

A change of environment (even though it is considerable) must, I believe, act for a very long period on a race before it perceptibly changes its racial characters.

At least, I know of no trustworthy evidence of the physical characters of a race being rapidly changed by its environment, except in modern industrial towns like Glasgow, and such rapid changes in the environment as have been produced by modern industrial development did not occur in the prehistoric times with which this investigation deals.

Assuming, therefore, this principle of the permanency of the average dimensions of a race, I proceed to inquire whether there is any special physical type of man associated with the British stone circles, and to determine, so far as is possible with the material available for comparison, the affinities and origin of this race.

In applying this method of anthropometrical analysis, it should be remembered that a significant difference between two groups of men in a single dimension proves that they cannot possibly belong to the same race. It does not, however, follow with the same degree of certainty that, if there is no significant difference between one or two dimensions, that the races are necessarily the same, but identity is the most reasonable assumption.

In one of the districts in which stone circles are most numerous, namely, in east Aberdeenshire, a very unique type of man has been found in short cists, associated with a special kind of pottery, namely, the "drinking vessel" which Mr. Abercromby has shown to belong to the transition period between the Neolithic and the Bronze age.

The average cephalic index of ten adult male skulls of this short-cist race, measured by Dr. Low, is 85·2, the average stature is 5 feet 3 inches, the average length of head is 181·1 mm., and the average breadth of head is 154·4.

Now the remarkable characteristic of this short-cist race is that its physical dimensions differ significantly from all the other groups of prehistoric races of Britain that have as yet been measured.

It differs enormously from the Neolithic race which preceded it. Of these we have two groups, one measured by Thurnam and Davis, having an average cephalic index of 71·9, and the other by Schuster, having an average cephalic index of 74·7.

Those who believe that the environment was capable of changing a race with an average index of 74 into a race with an average index of 85 must show that the Neolithic race was transported into an environment which is known, or at least surmised, to be capable of producing broad heads from long heads. It has been surmised that a mountainous environment has this effect, because we generally find broad heads inhabiting the great mountainous regions of Asia and Europe; but we find our short-cist broad heads in Britain, not generally in the mountainous regions, but in the lowlands lying adjacent to the sea coast.

There is no escaping the conclusion, therefore, that the short-cist brachycephals could not possibly have been evolved from the dolichocephalic Neolithic inhabitants of Britain.

There are, however, some prehistoric races in Britain that come much closer to the short-cist men than the Neolithic race.

The Bronze-age men of the round barrows have an average index of 79·3 according to Thurnam and Davis's measurements; another group from the east Yorkshire barrows, measured by Dr. Wright, give an average index of 77·3; and a third group, measured by Schuster, give an average index of 76·8.

Taking Thurnam and Davis's group as being nearest to the short-cist group, I find, on making the necessary statistical calculations, that the odds against short-cist men being a random sample of the round-barrow men are more than 25,000 to 1.

All the other prehistoric British groups, such as the Anglo-Saxon or Iron-age groups measured by Myers and Smith, are much further removed than the round-barrow men, so that there can be no question about these belonging to an entirely different race.

The modern Scotch skulls, taken principally from graveyards in the eastern counties of Scotland, and measured by Sir William Turner, evidently belong to much the same type as the round-barrow men, and are undoubtedly of different race from the short-cist men. The mediæval Kentish skulls at Hythe, measured by Dr. Parsons, though apparently belonging to a type not hitherto investigated, and having an average index of 79·3, nevertheless differ widely in their absolute dimensions, more especially in their breadth, from the short-cist skulls.

There is only one small group of five skulls found in Glamorganshire, and measured by Prof. Hepburn, which does not differ significantly in some one dimension from the Aberdeenshire short-cist skulls; and this group evidently belongs to the same race, and was found in a stone-circle district, two stone circles in this district being described in "Archæol. Cambr.," vol. v., 6th series.

Here, then, we have a race differing from all known racial groups, prehistoric or modern, in Britain. In Aberdeenshire and South Wales it is found closely associated with stone circles. No other prehistoric race, at least in the Aberdeenshire area, has been found associated with these circles.

The conclusion seems inevitable that the British stone circles were invented and built by a hyperbrachycephalic race of short stature which came from abroad, and apparently settled first, in the early Bronze age, in the district now known as Cornwall and Devon. From thence they migrated through Wales to Scotland by the route already described.

The Affinities and Origin of the Short-cist Race.

Since we can find no affinities to the short-cist race in Britain, we must examine the physical characters of the prehistoric races of the countries from whence migrations into Britain might be supposed to have come.

In Sweden, all the prehistoric races of the Stone, Bronze, and Iron ages have been measured by Retzius, and have average indexes, respectively, of 75, 74·1, and 70. There can be absolutely no affinity between them and the short-cist men. In Denmark, on the west coast, we have the Borreby type, which closely resembles our round-barrow men, but differs significantly from the short-cist men.

The most hopeful comparison appeared to be with the short, brachycephalic race in Switzerland, known as the "Disentis" type. This, according to His and Rütimeyer's measurements, has an average index of 86·5, but when the absolute dimensions are taken into consideration and the necessary statistical calculations have been made, I find that the odds against the short-cist men belonging to this type are more than 6000 to 1.

There appears to be no other likely race in Europe that could have sent, in the Bronze age, emigrants of the short-cist type to Britain.

We must look, therefore, to Asia, the habitat *par excellence* of brachycephalic man; and Asia Minor is undoubtedly the most likely starting point, at least for a seafaring race.

We have, unfortunately, no measurements of the prehistoric races of Asia Minor, but all authorities appear to be agreed that certain races who were the pioneers of civilisation in the East were brachycephalic, and apparently also of short stature. These brachycephalic races were known by various names, namely, Akkadians, Sumerians, Kassites, Khetan, and Hittites.

We have not the data absolutely to prove that this Turanian race of Mesopotamia and Asia Minor was identical with our short-cist race, but if we fail to find the mother race in Asia Minor we shall have to go much further afield.

There is one small item of positive evidence. The modern Chinese are said to be descended from the Akkadians, and of any type that has been investigated the modern Chinese skull most resembles in size and shape the short-cist skull.

If we should ever find a sufficient number of Akkadian or Hittite skulls to establish their physical type, the question would be settled. In the meantime, the physical evidence, so far as it goes, appears to me to be strongly in favour of the view that our short-cist men were a colony of Akkadians, Sumerians, or Hittites, who migrated to England by sea about 2000 B.C., probably in order to work the Cornish tin mines and the Welsh copper mines.

The Akkadians, according to Conder, in his recent book

on "The Rise of Man," were, in 2800 B.C., able to coast round Arabia and up the Red Sea to Suez. Why should they not be able a few hundred years later to coast round Africa and Spain and up the Atlantic to Britain?

In 2800 B.C., according to the same authority, the Akkadians were acquainted with silver, gold, bronze, and copper.

One of the most recent theories of the stone circles—that of Sir Norman Lockyer—is that they were astronomical observatories, by means of which the ancient priests made observations of the sun and stars, and were thereby able to regulate the calendar, to foretell and prepare for the festival seasons of the year, and to tell the time at night.

This theory is in remarkable agreement with the anthropometrical conclusions which I have just submitted to you, for the Akkadians were apparently the first inventors of astronomy. Gudea, the Akkadian prince, who lived about 2800 B.C., has left a stepped pyramid with an observatory on the top. The Akkadians were the astronomical race at the dawn of civilisation, and apparently the ideas of an astronomical race have been embodied in our British stone circles.

THE BRITISH ORNITHOLOGISTS' UNION.

The British Ornithologists' Union celebrated its fiftieth anniversary in the rooms of the Zoological Society on Wednesday, December 9. A special meeting was called for the occasion, the president of the union, Dr. F. D. Godman, F.R.S., occupying the chair, and reading an address on the history of the union from its foundation. The idea of forming this society was due, he remarked, to the late Prof. Newton, and was first mooted in his rooms at Cambridge during 1858; but it appears finally to have taken shape when, in the following year, at the meeting of the British Association at Leeds, the opportunity was seized of calling together a number of the ornithologists there assembled. The details of the constitution of the union appear to have been then discussed, and a few months later took their final shape. Limited for the first few years of its existence to twenty members, it was at last found expedient to remove this restriction. To-day more than four hundred members are on the roll. From the first it was decided to start a journal, and the name chosen for this was that of the sacred bird of Egypt, the *Ibis*. The history of the birth and growth of this now celebrated journal was traced later by Dr. Sclater, its first and present editor. After the addresses by the president and Dr. Sclater, gold medals were presented to the four survivors of the original founders, Dr. Godman, Mr. Percy Godman, Dr. Sclater, and Mr. W. H. Hudleston. This pleasant ceremony was followed by an appeal to the members from Mr. Ogilvie Grant, of the British Museum (Natural History), wherein he urged that the union should commemorate its jubilee by sending an expedition to explore the Charles Louis Mountains of New Guinea, probably one of the richest unexplored zoological regions of the world, and this was unanimously agreed upon. The union, of course, could not find the whole of the money necessary for such an undertaking, but a considerable sum has been promised by others interested in this work. The meeting was brought to a conclusion by a dinner held at the Trocadero Restaurant, after which Mr. Boyd Alexander gave a lecture on his recent journey across Africa, and this was followed by a kinematograph exhibition of pictures of bird life.

At a special general meeting, held in the same week, the union considered the report of a committee on a motion brought forward by Mr. H. F. Witherby at the last annual meeting. It was then proposed that the taking or killing of certain birds, or the taking of any egg of certain birds, or the purchase of any such egg knowing it to have been taken in the British Islands by any member of the union, should involve the removal of his name from the list of members. The prohibition with regard to birds was to apply all the year round to the bearded-top golden oriole, hoopoe, marsh harrier, hen harrier, Montagu's harrier, common buzzard, golden eagle, white-tailed eagle, kite, hobby, osprey, common bittern, spoonbill, Kentish plover, avocet, and chough. To the crested tit, snow-bunting, grey-leg goose, dotterel, red-necked phalarope, ruff, whimbrel, black tern, Sandwich tern, roseate tern, great skua, black-throated diver, red-throated diver, and greenshank it was only to apply for the breeding season, but it was to be in force for the eggs of any of the species named. After discussion, it was agreed that if in the opinion of the committee any member shall have personally assisted in or connived at the capture or destruction of any bird, nest, or eggs in the British Isles, by purchase or otherwise, likely in the opinion of the committee to lead to the extermination or serious diminution of that species as a British bird, steps shall be taken, after due inquiry, to remove the offender's name from the list of members.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

The Most Rev. Dr. Walsh, Roman Catholic Archbishop of Dublin, has been elected Chancellor of the new National University of Ireland.

The Berlin correspondent of the *Daily Chronicle* announces that Prof. Ernst Haeckel, professor of zoology at the University of Jena, is about to retire into private life after forty-eight years' professorial activity. He will be succeeded by Prof. L. Plate, professor of zoology in the Berlin Agricultural High School.

University College, Reading, has issued a special list of courses in poultry keeping to be given there, with practical training at the college poultry farm, Theale, inclusive of theoretical and practical teaching in this subject. Additional lectures are given by members of the staff on zoology, soils, manures and pastures, chemistry of foods, and bookkeeping.

The current number of the *Empire Review* includes an article on the Imperial College of Science and Technology by Dr. Henry T. Bovey, F.R.S., the rector of the college. After giving a brief historical *résumé* of the growth of the Royal College of Science, the Royal School of Mines, and the Central Technical College, Dr. Bovey explains the work of the Departmental Committee appointed by the Board of Education in 1904, the issue of the charter of July 8, 1907, creating the Imperial College, and the constitution of the governing body. The aims and objects of the new college are then dealt with, and in this part of his article the rector follows very closely the able address he delivered to the students at the opening of the session last October, which was published in full in our issue for October 15 last (vol. lxxviii., p. 613).

The Department of Agriculture and Technical Instruction for Ireland has arrived at an agreement with the Commissioners of National Education in Ireland for providing means for the training of national-school teachers in elementary experimental science and domestic economy as part of local schemes of technical instruction. The Commissioners are prepared to recognise teachers, who hold certificates of satisfactory attendance at classes approved by the Department, as qualified to give instruction in the subjects named. The Department has circulated copies of the regulations which will govern the classes to be inaugurated and syllabuses of courses of instruction in both subjects. Each course extends over three years, is well graduated, and skilfully adapted to the needs of teachers in elementary schools. The third year's course in elementary experimental science provides instruction in rural economy, and it is so framed that in a few years' time Ireland should possess elementary-school teachers able and desirous of basing the science teaching of country schools upon the everyday surroundings and experiences of the children.

The annual prize distribution at the Sir John Cass Technical Institute was held on Wednesday, Decembe when the chair was taken by Sir Owen Roberts, chai. of the governing body. The prizes were distributed b Mr. Lewis F. Day, after delivering an address, in which he dealt with the mutual dependence of design in art and craft work and their relation to trade, and concluded with

a statement of his views as to the aim and end of technical training. Mr. Day pointed out the value of the association of the work of the science side of the institute with the study of the artistic crafts and with the bearing of science upon design. It was, in his opinion, of great value to develop so far as possible a more intimate association than ordinarily exists between different branches of teaching, so as to familiarise the craftsman with the methods, the aims, and the applications of science. Previous to the distribution of the prizes, Mr. George Baker, chairman of the institute committee, in reporting on the work of the past session, referred to the fact that the prizes that had recently been presented to the institute by the Goldsmiths' Company for the department of metallurgy had been awarded for the first time. The first of these prizes was given for the best piece of research work carried on in the department of metallurgy during the past session, and he recorded with great interest that three very satisfactory investigations had been done during that period.

The issue of the *Oxford and Cambridge Review* for the Michaelmas term contains an unusually large number of articles dealing with subjects connected with higher education. Dr. F. C. S. Schiller discusses exhaustively the whole question of scholarships at the public schools and the universities under the title of "Eugenical Scholarships." The particular title adopted is justified, because the thorough examination of recent proposals to restrict public scholarships to the children of poor parents leads up to a consideration of the matter from the point of view of eugenics. Intelligence and ability, says Dr. Schiller, are hereditary; the probability of getting able children is vastly greater if they spring from able parents; intelligence and ability lead to success among professional men; for men so situated the institution of scholarships is simply invaluable, since it acts as a great eugenical inducement, and is calculated to augment the supply of valuable citizens. Mr. R. J. MacKenzie, late rector of Edinburgh Academy, in an article on school examinations, points out how the multiplicity of examining bodies all examining for similar purposes leads to waste of time, money, and energy in secondary schools, and pleads for a universal "secondary-schools' leaving examination" for England and Scotland. The same issue of the *Review* contains an essay entitled "The Idealistic Interpretation of Prof. Ostwald's Theory of Energy," by Mr. J. Butler Burke, and articles on other educational matters.

SOCIETIES AND ACADEMIES.

London.

Royal Society, June 25.—"Dichloro-urea." By Dr. F. D. **Chattaway**, F.R.S.

There is probably no substance among the almost bewildering number known to chemists which surpasses urea in interest, or which has been more frequently and carefully investigated. It has been so much studied from almost every point of view that a new simple derivative was scarcely to be expected. Such a new simple derivative is, however, found in the recently discovered chlorine substitution product.

This is produced when chlorine is passed into a cooled saturated aqueous solution of urea. Action takes place without any considerable development of heat, and a compound crystallises out in which two of the four hydrogen atoms of the parent substance are replaced by halogen. Dichloro-urea obtained thus is a soft, white crystalline powder, consisting of thin transparent plates, which can be preserved for a considerable time in a dry atmosphere, although, as might be expected, it is not very stable.

Having regard to its composition and mode of formation, as well as to the structure of urea itself, its constitution must be represented by the formula

$$\begin{matrix}H\\Cl\end{matrix}\!>\!N-CO-N\!<\!\begin{matrix}H\\Cl\end{matrix}$$

which explains its formation and such of its reactions as have yet been studied. From this structure, and the fact that heat is absorbed when it is formed, it might be expected to be highly explosive. When heated, however, it does not itself explode, but decomposes at about 83° C. with liberation of the vapour of nitrogen chloride. The latter, if it is not allowed to escape, and if the temperature is raised a few degrees higher, detonates with great violence.

Dichloro-urea is a compound of a marked acid character; it has a sour taste, recalling that of hypochlorous acid, and its aqueous solution strongly reddens litmus paper, which only becomes bleached after the lapse of some minutes. It acts very corrosively upon the skin, staining it yellow and destroying the tissues, and gives all the reactions characteristic of compounds in which chlorine is directly attached to trivalent nitrogen. It is distinguished from most other substances belonging to this class of compounds by the readiness with which it is hydrolysed, nitrogen chloride, carbon dioxide, a little nitrogen, and ammonium chloride being produced.

Dichloro-urea is instantaneously decomposed by a solution of caustic potash, two-thirds of the contained nitrogen being liberated as gas with violent effervescence, while the remaining one-third appears as ammonia, which, together with the alkaline carbonate also formed, remains dissolved in the liquid.

This behaviour of dichloro-urea gives an insight into the course of the reaction which occurs when urea is decomposed by an excess either of alkaline hypochlorite or hypobromite. This decomposition, which has received an extraordinary amount of attention, as it furnishes a quick, though not very accurate, method of estimating the quantity of urea present in a liquid, has never been properly explained, and is generally represented by an equation which makes it appear to be a case of oxidation. Dichloro- or dibromo-urea or some analogous compound is without doubt formed as an intermediate product, the action being thus one of halogen substitution followed by decomposition of the substituted urea by the excess of alkali present.

It may be noted that dichloro-urea is safe to handle, and promises to be of considerable use as a synthetic agent.

Royal Astronomical Society, December 11.—Mr. H. F. Newall, F.R.S., president, in the chair.—The determination of the apparent diameter of a fixed star: Major P. A. **MacMahon.** But little certainty is to be attached to existing estimates of the diameters of fixed stars, and a direct method, independent of the star's parallax, is much to be desired. The author proposed to apply the principle of the bioscope to the photography of occultations of stars by the moon. It was shown that a star might have an apparent diameter of 1/1000th of a second, and that the time taken by the moon to occult a fairly bright star might give an approximate measure of such a diameter. Prof. Dyson said he entirely agreed with the principle of Major MacMahon's method, and hoped that results might be obtained in the case of bright stars occulted by the dark limb of the moon. It would be necessary to employ a reflecting telescope of large aperture, and extremely sensitive plates.—The **Astronomer Royal** showed further photographs of comet *c* 1908, Morehouse, in continuation of the series exhibited at the last meeting, carrying the record to November 25, after which the moon interfered, and the comet got too low. The structure of the tail still showed detail of great interest, including the apparent dark rifts, though the cyclical changes seen in September and October did not appear to continue. A further series of photographs of the comet, taken by Prof. Barnard at the Yerkes Observatory from October 16 to November 19, was also shown.—The comet of 1556: its possible breaking up by an unknown planet into three parts, seen in 1843, 1880, and 1882: Prof. George **Forbes.** The three latter comets formed a group, closely related to each other, and the author gave his reasons for considering that the disruption of the comet of 1556 occurred through the influence of an ultra-Neptunian planet, which his calculations showed to exist at a mean distance from the sun of about 100 celestial units, with a period of about 1000 years and an inclination to the ecliptic of about fifty degrees. Some search had been made for the supposed planet, but only in the region of the Zodiac, so it was not surprising that the results had been negative.—An

improved telescope triple object-glass: J. W. **Gifford.** The method and formulæ for figuring and testing were described and illustrated.

Royal Meteorological Society, December 16.—Dr. H. R. Mill, president, in the chair.—Some forms of scientific kites: Eric S. **Bruce.** Some forms of scientific kites were described other than the well-known box-kite invented by Mr. Hargrave. This is heavier and more breakable than many other forms of kites, but it possesses the indisputable advantages of stability, ascending steeply and exerting great force. When there is wind enough to fly it, it would appear unsurpassed. It is, however, advisable that meteorological kite ascents should be carried out as continuously as is possible, and that as many as possible of those days when the heavier box-kite will not rise should be utilised for obtaining information. On this account Mr. Bruce considers that lighter forms of kites, which are specially adapted for use in very light winds, would be of great service. He then described the Brogden six-winged bird-kite, the Salmon eighteen-winged kite, the Barclay honeycombed-kite, the Cody bat-winged box-kite, the Balston butterfly-kite, and the Burgoyne aluminium kite.—The registering balloon ascents in the British Isles, July 27 to August 1, 1908: C. J. P. **Cave.** These ascents were made in connection with the extended series of ascents of kites and balloons arranged by the International Commission for Scientific Aëronautics. Some of the records show considerable differences of temperature between the up and the down traces, which seems to indicate that fairly rapid fluctuations of temperature may occur in the upper air. The average height reached was 10·2 miles, the greatest height being 14·3 miles. All the balloons except one reached the isothermal layer, and show that the diminution of temperature with height ceases after a certain point, or that there is a rise of temperature; the rise of temperature is quite marked, even in the case of balloons which have attained their highest point after sunset, and cannot, therefore, be the effect of solar radiation.—Balloon observations at Ditcham Park, near Petersfield, July 27 to August 2, 1908: C. J. P. **Cave.** The registering balloons which were sent up were followed by means of theodolites for the determination of wind velocities at different heights. The balloons were observed until after they had entered the isothermal layer, and in each case there was a well-marked diminution of wind velocity at its lower limit.

DUBLIN.

Royal Irish Academy, December 14.—Dr. F. A. Tarleton, president, in the chair. Extensions of Fourier's and the Bessel-Fourier integral theorems: Prof. W. McF. **Orr.** Hankel's fundamental equation is obtained with an extension to functions of any order, real or complex; the parameter is regarded as complex, the ordinary line integral from zero to infinity being replaced by one taken along a contour in which the limits of the parameter are a positive and a negative infinity. This is done by first obtaining equivalent equations in the K functions, the contour being deformed into one everywhere at infinity; along this each function may be replaced by the dominant term in its asymptotic expansion, and when this is done the required results follow by Fourier's integral theorem. Precisely similar theorems are obtained in which the Bessel functions are replaced by their derivatives of any, but the same, order. Expansions are obtained suitable for the discussion of vibratory motion in the space outside a sphere or an infinite cylinder; for example, an arbitrary function of r is expressed, for values $>a$, by an integral the element of which is a multiple of

$$\{J_n(\lambda r)J_{-n}(\lambda a)-J_{-n}(\lambda r)J_n(\lambda a)\}d\lambda.$$

The author believes that the investigations are valid for functions which satisfy Dirichlet's conditions, and for no others.

NEW SOUTH WALES.

Royal Society, October 7.—Mr. W. M. Hamlet, president, in the chair. The influence of infantile mortality on birth-rate: G. H. **Knibbs.** It is shown from the statistics of all countries furnishing accurate statistics that:—(1) For any one country uniform increments to the rate of infantile mortality tend to produce uniform increments in the birth-rate; that is to say, the birth-rate β_0, which would correspond to an absence of infantile mortality, is given by the equation $\beta_0=\beta-b\mu$, where β is the actual birth-rate, μ the rate of infantile mortality, and b a constant peculiar to each community or country. (2) The coefficient showing the influence of infantile mortality on the birth-rate as actually deduced is in all cases very small. (3) No general law exists for the world as a whole. (4) The constant b does not appear to be influenced by the magnitude of the birth-rate itself, since it is approximately the same for a country with a low birth-rate (such as France) and a high birth-rate (such as the Netherlands). (5) That the *a priori* tendency of increase of birth-rate through increased rate of infantile mortality may be masked by other influences.

CONTENTS.

THURSDAY, DECEMBER 31, 1908.

ESSENTIAL OILS AND ESSENCES.

The Chemistry of Essential Oils and Artificial Perfumes. By Ernest J. Parry. Second edition, revised and enlarged. Pp. viii+540. (London: Scott, Greenwood and Son, 1908.) Price 12*s.* 6*d.* net.

THE chemistry of the essential oils is one of the most interesting, and at the same time one of the most complicated, sections of plant chemistry. To begin with, the true function of an essential oil in the economy and life-history of a plant is by no means clear. It might at first sight be thought to be connected with the reproductive agencies of the plant, and possibly as regards the flower this may be the case; a fragrant smell in the flower may be the means of attracting the insects which carry the fecundating pollen. But that the attraction of insects is not the sole function of an odoriferous oil must be obvious from the circumstance that many essential oils, as in the conifers, are to be met with in practically all parts of the plant; some are found in the fruits, and a few even in the roots. At the same time, there is much evidence to show that the occurrence of an essential oil in a plant is frequently directly related to processes which ensure the continuance of the species. The amount increases with the growth of inflorescence and decreases after the flowering period is past. But certain oils appear to be the result of metabolic changes which are not necessarily connected with reproductive processes. Thus the essential oil of almonds is a product of the decomposition of amygdalin under the influence of the ferment emulsin. Oil of mustard is similarly produced from a specific glucoside by the agency of myrosin.

The whole subject has hardly received that attention from plant physiologists that its importance and interest demand. Experimentally it is confessedly most difficult, owing to the imperfection and restricted character of the analytical methods at the investigator's disposal, especially quantitatively; and it is, of course, accurate quantitative methods which are most needed in correlating the life-history of the plant with the occurrence and distribution of the fragrant oil.

The volume before us is the second edition of a work which made its first appearance in 1899, and it differs from its predecessor in several important particulars, partly in omissions, but more especially in extensions. Thus as regards the chemical nature of the essential oils, a comparison of the present volume with that of the first edition will serve to show the striking developments that have taken place in the interval. It is true that we have had no substantial addition to the main groups to which the various proximate principles occurring in essential oils may be referred, but the number of such substances has been greatly increased, and their physical characteristics, constitution and mutual relations have been far more accurately determined. The general survey of the chemistry of the subject given by Mr. Parry in the second chapter is as full as the limitations of space in a book not primarily intended for theoretical chemists would allow. The chapter on the preparation of the essential oils is, however, disappointing, especially in a work which professes to deal with the technology of the subject. The author practically contents himself with a statement of the principles of the main processes—expression, distillation and extraction in general use, and omits all detail on the ground that details could not yield the practical man nearly so much information as could be obtained during a short stay in a factory. No doubt, in general, practice is worth more than precept, but if every technologist treated the practical aspects of his subject in this way technology would cease to exist.

By far the largest, and indeed the most valuable, section of the work is concerned with the systematic study of the more commercially important essential oils. This section constitutes about half the entire work. Great pains have evidently been taken in its compilation, and, so far as we have been able to discover, nothing of material importance relating to the origin, mode of manufacture and properties of any particular oil would appear to have been omitted. It need hardly be said that the well-known contributions which Messrs. Schimmel and Co. periodically make to the literature of the subject have afforded the author much of his information. Indeed, it must be admitted that the amount of actual original matter other than analytical data which he has been able to contribute to his work is not very extensive, and he has to depend upon others for the greater part of what he has to say relating to the origin and mode of extraction of the products he describes.

Since Tiemann's discovery of vanillin, which he first obtained from the glucoside coniferin more than a third of a century ago, a considerable number of so-called synthetic perfumes have been prepared, notably coumarin, heliotropin, ionone, artificial musk, and neroli. Vanillin, which is methyl protocatechuic aldehyde, is now obtained on a considerable scale from eugenol, the main constituent of oil of cloves, and also from guaiacol, as well as by other methods, and is largely used in confectionery. Costing as much as 160*l.* per lb. in 1876, it is now quoted at about 18*s.* Coumarin, originally discovered in the tonka bean, is found in a great number of plants, and was first synthetically obtained by Perkin. The synthetic product is now employed to a considerable extent in place of the tonka bean, as, for example, in the preparation of the well-known perfume *foin-coupé*.

Heliotropin is the methylene ether of protocatechuic aldehyde, and was first obtained from piperine, the active principle of pepper, and is now prepared from safrol. When first discovered its price, in 1880, was 70*l.* per lb.; it now costs about 8*s.* per lb.

Ionone, the artificial violet perfume, now largely employed in perfumery, was first obtained by Tiemann and Krüger in 1893. The preparation of these various substances artificially constitutes one of the triumphs of synthetic chemistry, and has given a great impetus to the manufacture of artificial perfumes. Practically all that has been up to the present made known on this subject is set out in detail in the last chapter of Mr.

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Parry's book. Incidentally the question of what is brandy is elucidated by what is stated respecting the nature of artificial cognac oil, which, however, strictly speaking, is not an essential oil. There is, as the author says, an almost unlimited field of research in the synthetic production of perfumes. The field is still practically untilled, and a rich harvest awaits the successful cultivator.

It is, however, a moot point whether any individual synthetic perfume is the equal, from the perfumer's point of view, of the corresponding natural perfume. Some of these synthetic perfumes in the pure or concentrated state in no wise resemble the natural variety; in fact, in this state they are almost repellent, and it is only when judiciously blended and diluted that their fragrance becomes pleasurable.

The fragrance of a natural perfume is in all probability not wholly due to a single substance or a single stimulus. Some one substance may be there in relatively large proportion, but associated with it are other odoriferous substances, some of them, possibly, in minute amounts only, but all of them contributing to an olfactory sensation which gives pleasure. A perfume, in fact, is like a piece of music. There may be in the piece a dominant musical idea, but the pleasure it creates is largely dependent upon its association with tone-sensations which are not necessarily structural parts of the dominant idea. Synthetic perfumes, therefore, can only successfully replace natural perfumes when the greatest care and judgment are exercised in blending. This kind of blending rises to the level of a fine art. To be successful in its exercise the olfactory sense of the blender requires a training hardly less rigorous than that required by the auditory sense of the musician.

This work, with all its limitations, is still the most complete treatise on the subject in our language, and as such is indispensable to the pharmacist, the perfumer, as well as to the analytical chemist who may be concerned with the examination of a class of substances of varying character and peculiarly liable to sophistication.

A MONOGRAPH ON THE FROG.

Der Frosch. Monographien einheimischer Tiere. Band i. By Dr. F. Hempelmann. Pp. vi+201. (Leipzig: W. Klinkhardt, 1908.) Price 4.80 marks.

THIS monograph, the editor informs us, has arisen in connection with elementary biological teaching at Leipzig, and is intended to describe not only the habits, structure, and development of "the physiologist's domestic animal," but to form an introduction to physiology, psychology, the mechanics of development, classification, and distribution. It is in respect of its scope that this addition to the vast literature on the frog differs from its predecessors. At the same time it is written for beginners, and must be judged from its value as an introductory handbook to practical dissection and experiment

We may say at once that taken as a whole it is a well-written and successful attempt to compress all that is important and well established concerning the frog into 200 pages. But that is far more than an elementary student can assimilate, and between what he is first to notice and what he will only notice after the primary difficulties are overcome there is no means of distinguishing.

We regret that no mention is made of Marshall's famous book, and also that figures taken from his works are borrowed merely from reproductions of them by other authors. This neglect of Marshall is, however, no isolated case of the omission of some of the most important English works on the frog, both educational and other. There is surely no more important work on the distribution and systematic aspect of Amphibia than Boulenger's "Tailless Batrachians," nor is there a more readable account of the various aspects of this very animal than that by Holmes, published some two years ago. Lister's classical researches on the pigmented cells are nowhere referred to, whilst a small and almost unknown compilation by St. John Mivart more than thirty years old is quoted.

The first section, that on anatomy, is based on Gaupp's well-known edition of Ecker's work. Histology begins on p. 6, and the student is plunged into a study of the structure of the integument before the terms "cell," "transverse section," and "gland" are made clear. The apparently inevitable and complicated nomenclature reaches its maximum in connection with the brain, where no fewer than four sets of terms are used for each region. The difficult and complicated question of how the heart distributes arterial and venous blood requires a fuller sketch of the heart itself than is given on p. 54; whilst the equally difficult problems of development, *e.g.* of what are meant by "pronephros" and "mesonephros," are scarcely alluded to. The writer does not seem to appreciate the difficulties of beginners in regard to these unfamiliar conceptions.

The second section—physiology—is much better done, and the general features of metabolism are clearly explained. Then follow sections on heat-production, colour-change, movements, and the elementary physiology of muscle and nerve, leading up to a discussion of psychology and the development of consciousness. Some account is given of the experimental side of development, in which, however, we miss any reference to Assheton's work on the growth of different regions; in fact, the phenomenon of growth does not appear to be treated anywhere in the book. The references to sex-determination (pp. 162–4) in our present ignorance are inconclusive, and might well have been omitted.

Lastly, we come to "Biologie" (it is difficult to see why this, the most interesting part of a treatise, is always put at the end by German writers) and classification. Here we must agree to differ from the author. The common brown grass frog has always been *Rana temporaria* to us, but to find it described as *Rana muta laurenti* is indeed a shock. There is really no good ground for this change. The tendency needlessly to upset well-established names is a most regrettable feature of systematists; but to introduce confusion without any right, explanation or apology into a book

intended for elementary students is really an offence. We recommend the remarks of Boulenger ("Tailless Batrachians of Europe," Ray Society, p. 301) to the author.

MODERN ORGANIC CHEMISTRY.

Recent Advances in Organic Chemistry. By Dr. A. W. Stewart. With an introduction by Prof. J. N. Collie. Pp. xv+296. (London: Longmans, Green and Co., 1908.) Price 7s. 6d. net.

UNLESS the chemist, and especially the organic chemist, adopts some elaborate system of grouping together new information as it appears, the mass of research which nowadays floods the journals makes it difficult for him to keep abreast of current investigations.

The reports of the British Association on organic chemistry have served a most useful purpose in giving summaries of recent work; but they are too few in number. It appears to us that if the Association's funds could be utilised in extending this part of its activities, they would be well spent. Three or four reports a year on different branches of chemistry would be invaluable. But until we have something of this kind we must rely on individual effort to supply the want. This, we take it, is the main object which Dr. Stewart had in view in writing his book, and we congratulate him on the result, which has taken the form of a compact, neatly bound and well-printed volume at a very moderate price. The compilation has been carried out with great discrimination. It is not an easy matter to discuss details of modern structural formulæ and at the same time to sustain the interest of the reader. But Dr. Stewart has an easy and pleasant style, and, if his criticisms are occasionally rather forcible, they only add piquancy to the subject under discussion.

We think the author takes too despondent a view of the present trend of organic chemistry. We are, it is true, deluged with new compounds, which seem destined to bear no fruit, but the worst that can be said of them is that they add to the bulk of our already ponderous journals.

Nor are we of the author's opinion in thinking that "we have accumulated an immense mass of data concerning the results of reactions, but very little indeed with regard to their causes." The very volume before us serves to negative the statement, for the book bristles with facts upon which theories are based.

We do, however, most heartily agree with him in emphasising the need for studying exceptions to general theories, and there is no doubt that therein lies a fruitful field of study. Our knowledge of the mechanism of most, even of the simplest, reactions is incomplete. We know the end result, but not the intermediate steps. Moreover, there is scarcely any general reaction which is not modified to some extent in its individual applications, whereby we are forced more and more to recognise reactivity as a function of environment. But surely this is no cause for discouragement. There are still new worlds to conquer, and perhaps Dr. Stewart's book may induce chemists to give their attention to these neglected problems.

That the author appears a little impatient of those whose attitude towards new theories is hesitating, and perhaps conservative, is perhaps natural. But it must be remembered that our mechanical concepts of atomic relations are not easy of proof, and dynamical concepts much less than statical ones. Van 't Hoff's theory has afforded overwhelming evidence of the value of the statical idea, for it is the very essence of stereochemistry, and fits in admirably with the theory of atomic linking and the existence of dynamic isomers. The foundations of organic chemistry are laid on a statical basis. It is only natural, therefore, that the explanation of the physical properties of compounds should bear a direct relation to this fundamental idea. No one doubts that the statical concept is an incomplete one. It is equally certain that the whole story of molecular forces will only be known when physical and chemical properties are grouped under one comprehensive idea. But there is no reason why new theories should not be grafted on the old, deep-rooted stock, until it may be safely transplanted. We must only be sure that any theoretical development is capable of experimental study, and in this connection it is doubtful if electrons and Faraday tubes, whatever theoretical value the physicist may attach to them, will prove more serviceable to the organic chemist than vortex atoms.

The book is divided into chapters or essays dealing with those topics which have attracted special attention during the last decade. It opens with a good general account of Grignard's reaction and asymmetric synthesis. Then follows a chapter on polyketides, that is, bodies containing the $CH_2.CO$ or ketene group or its multiple, which is illustrated from the work of Collie, Staudinger, and Wilsmore. This is followed by a chapter on recent synthetic preparations of *cyclo*paraffins, which the author terms "polymethylenes." There are essays on recent work on the terpenes, alkaloids, and polypeptides. An interesting, though a very brief, account is given on the action of light on organic compounds which embodies much of the work of Ciamician and Silber, and there are chapters on addition reactions and unsaturation, in which the author has something to say about his own investigations. The volume closes with a chapter touching on modern views and the inadequate nature of structural formulæ, and there is, finally, an excellent bibliography of organic chemical literature, which affords convincing testimony of the utility, if not necessity, to all organic chemists of an adequate knowledge of the German language.

J. B. C.

THE CURVATURE METHOD OF TEACHING GEOMETRICAL OPTICS.

Geometrical Optics. By V. H. Mackinney and H. L. Taylor. Pp. iii+128. (Birmingham: J. and H. Taylor.)

THE preface to this little book is somewhat misleading. We there read:—"The growing demand for a book on Geometrical Optics based upon the Curvature system has led to the production of this small volume. . . ." If the use of the curvature

method constituted the chief characteristic of the book, we should have but little to say in its favour. The curvature method undoubtedly possesses many obvious advantages, but the loose and in places quite inaccurate manner in which the elementary theory of mirrors and lenses is here set forth does much to obscure the merits of the system.

The definition "The curvature of a circle is the angle through which a curve turns per unit length" gives an early suggestion of the lack of logical clearness which is throughout apparent. As an instance of more serious inaccuracy the following attempt at an explanation of the formation of an image by a concave mirror may be quoted (p. 18):—

"To explain the formation of the virtual erect image we may imagine the mirror to consist of an infinite number of plane surfaces (Fig.). Each of these is capable of producing a virtual and erect image (as previously explained) identical in position behind the mirror with the object in front. As the object is moved from the mirror more of these supposed innumerable facets take up the reflection for the eye to view, and so the image increases rapidly in size. . . ."

The attempt at a formal proof, for the spherical mirror, of the relation connecting conjugate foci is given later (p. 38). With no guidance as to the conditions limiting the truth of the statements made, and with a misleading figure, we venture to think that the intelligent student would find this hopelessly bewildering.

In fact, however, no real attempt is made to establish, by the curvature method, the principles of elementary geometrical optics. Apart from the statement in the preface one would have judged the aim of the book to be quite different from this. It would appear clearly to be intended for the use of those actually engaged in optical workshops, and especially those concerned with the practice of spectacle making and of sight testing. It would seem to aim, not at providing a logical exposition of elementary principles on any system, curvature or other, but at furnishing a reader of the kind suggested with a sufficient modicum of information about many points likely to be brought under his attention in the course of his practice, to enable him to deal with these not unintelligently. From this point of view it may fairly be held to have achieved some measure of success. Evidently written by practising opticians, it does contain, in small compass, a good deal of practically useful and important information not to be found in the ordinary elementary text-book, more especially in regard to the characteristics of the eye as an optical instrument and the problems involved in the correction of its defects. The fact that the discussion of such questions is more readily carried on in terms of curvatures and focal powers than of radii of curvature and focal lengths may, perhaps, be held to account in some measure for the sentence quoted from the preface.

The book has some features of value to those for whom quick reference is essential: a useful summary at the end of each chapter; a few tables and data, including a table of aberrations in lenses and their remedies, from a paper read by Prof. Silvanus Thompson before the Optical Society; a list of optical works; and, following the index, a list of articles useful in spectacle work and sight testing, with approximate prices.

As a text-book on elementary optics the book needs mucn careful revision. We think well enough of it to express the hope that it may receive this treatment without delay.

ECONOMIC ZOOLOGY.

Economic Zoology, an Introductory Text-book in Zoology, with Special Reference to its Applications in Agriculture, Commerce and Medicine. By Prof. Herbert Osborn. Pp. xv+490; 269 figures. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1908.) Price 8s. 6d. net.

A Manual of Elementary Forest Zoology for India. By E. P. Stebbing. Pp. xxiii+230+xxxiv; 422 figures. (Calcutta: Superintendent Government Printing, 1908.) Price 15s.

THE teacher of zoology to students whose chief interest in the science depends upon its relations to some branch of human industry has often to decide whether he shall give the more prominent place to general principles or to special and technical applications. The rival points of view are well illustrated in these two works. Prof. Osborn, in the introduction to his handy "text-book," rightly advocates the claims of sound general principles.

"Inasmuch," he writes, "as economic zoology is simply an application of our knowledge of animals which affect human interests, it is easy to see that almost any phase of the study will have some bearing on the problems that concern us. Economic zoology, if studied thoroughly, must of necessity be based on accurate knowledge . . . so that it involves a study of the whole animal and all that can be learned regarding its activities."

In agreement with these principles, the author has, in the work before us, neglected no groups of the animal kingdom, even though, like the Echinoderms and the lower Chordata, they have little or no "economic" importance, so far as we know at present. A knowledge of the structure of these groups is essential to any real training in zoology; and who, a dozen years ago, could have foreseen the vast economic importance of such groups as the Hæmosporidia, the Culicidæ, and Ixodidæ? The students now in our colleges require training not only for the known needs of the present; they are entitled to be equipped so that they can grapple practically with the unknown problems of the future.

But while the principles that have guided Prof. Osborn are thoroughly sound, it is doubtful if he has made the best possible use of the space at his disposal in thus applying them. He has given clear descriptions of the great animal phyla from Protozoa to Vertebrata, and the leading classes and orders, illustrated by well-chosen figures culled from trustworthy sources. Such descriptions are, however, already available in many zoological text-books. The special text-book for the student of economic zoology should

contain summaries of those detailed accounts of families and species, injurious or useful to man and his domesticated plants and animals, at present to be found only in scattered original papers or in expensive advanced treatises. In this respect the book must be pronounced disappointing. Prof. Osborn is well known for his original work on insects parasitic on domestic animals, yet here he dismisses the Anoplura in seven lines, the Mallophaga in a single short page, and refers to the Oestridæ only by reproducing two figures of horse bot-fly and its larvæ, not even mentioning this most important family in his text. Similarly, in the section on the Hymenoptera there is no special account of the saw-flies. Such omissions are not compensated for by outlines of morphology and classification, which, though the economic student ought indeed to know them, and know them well, he can find in half-a-dozen good elementary manuals.

There is another branch of zoological inquiry which, though most fundamental and important to the economic student, is superficially dealt with in most elementary text-books—the branch that deals with the factors of evolution. A fairly full and critical summary of modern developments of the theory of descent would be of vast benefit to the scientific agriculturist, for example. Prof. Osborn discusses these questions in eight pages, and the summary is necessarily so condensed as to be practically useless to a beginner. It were surely better to make no mention at all of the Darwinian and Mendelian theories than to describe them in ten and fourteen lines respectively.

A word of praise is due to the clear printing of the book and to the illustrations, which, with a few exceptions—printed so darkly as to be almost unrecognisable—are very well reproduced.

While Prof. Osborn's book is written mainly from the standpoint of the North American worker, Mr. Stebbing's deals almost exclusively with Indian forest zoology. After a general introduction, in which the principles of structure are illustrated mainly from the Vertebrata, the invertebrate phyla—except the Arthropoda—are dismissed in six pages. The Arthropoda are described in 148 pages, and of these 136 are devoted to an account of the Insecta. The chapters included in this section form the original and valuable part of the book. The author states in his preface that it could not have been written seven years ago, and the number of life-histories of forest insects, especially among the Curculionidæ and Scolytidæ, described and figured bears testimony to the industry and power of observation displayed by Mr. Stebbing. Unfortunately, many of his drawings have been very coarsely reproduced; our Government publishing departments—both at home and "beyond the seas"—have much to learn, for the heavy, unattractive appearance of too many scientific works marks their "official" origin at a glance. In some cases, however, Mr. Stebbing's photographs and figures have been treated with full justice; for example, the stages of Hoplocerambyx in a sal tree (Figs. 103, 194) form a beautiful and instructive picture. In following Dr. Sharp's volumes of the "Cambridge Natural History," it is unfortunate that Mr. Stebbing should have copied the antiquated arrangement of insectan orders now abandoned by Dr. Sharp himself. It is disappointing also to find that both Mr. Stebbing and Prof. Osborn retain the unnatural "Class Myriapoda."

The concluding section of Mr. Stebbing's book comprises short accounts of the classes, orders, and leading families of Vertebrata, with special reference to the Indian fauna, illustrated with cuts mostly reproduced from the volumes of the "Fauna of British India." The most valuable feature of these summaries is in the accounts of damage done to forests by various mammals and birds. Indeed, in Mr. Stebbing's book, as a whole, we have prominence given to the practical and technical aspects of zoology rather than to those general facts and principles on which Prof. Osborn lays the greater stress. G. H. CARPENTER.

OBSERVATION, STUDY, AND NAMING OF PLANTS.

Nature Rambles in London. By Miss K. M. Hall. Pp. xviii+325. (London: Hodder and Stoughton, n.d.) Price 3s. 6d. net.

Life Histories of Common Plants. By Dr. F. Cavers. Pp. xvi+363. (Cambridge: University Tutorial Press, Ltd., 1908.) Price 3s.

The Young Botanist. By W. Percival Westell and C. S. Cooper. Pp. xxxix+190. (London: Methuen and Co., n.d.) Price 3s. 6d. net.

PUBLIC gardens and parks provide better facilities for the observation of trees and shrubs than it is possible to obtain on rambles in the country, so that dwellers in London have full opportunity for pursuing the study of these objects. Unfortunately, many of the numerous visitors who frequent the parks have not the necessary knowledge or lack the training required to make the best use of their opportunities. For these Miss Hall has prepared the notes on nature rambles, written in non-technical language, and arranged according to the seasons' changes. Apart from the discourses on trees, a considerable amount of space is devoted to the descriptions of the birds that reside in or frequent the parks, and not the least interesting pages tell of the bee-hive that is located under Miss Hall's charge in the Stepney Gardens. The descriptive text is set off by the illustrations supplied by Mr. H. Irving, who has established a reputation for his photographs of natural history specimens.

The title of Dr. Cavers's book may suggest a series of short monographs on selected types; it furnishes, however, a compendium of the morphology and physiology of the flowering plants, followed by chapters on special orders or allied groups of plants. For the study of elementary botany the course delineated is both natural and practicable. The early portion of the book follows somewhat similar lines to the author's "Plant Biology," but is not so full, and is written in a more direct, *i.e.* less interrogative, form. Physiology provides the fundaments of the training, and a full set of experiments is outlined to enable the student to gather his principles from personal observation or from attempted experiments, as some are too uncertain for the student to manipulate.

The notes on the different plants supply the opportunities for considering accessory problems; thus the scarlet runner introduces twining, the marsh marigold leads up to a discourse on marsh plants, and so on. The volume concludes with a short epitome of ecological principles, while at the end of each chapter searching questions are proposed for solution. The author is to be congratulated on the excellent features of his book, which may be summarised as a clear diction, a logical sequence, and a recognition of the essentials.

The volume prepared by Mr. Percival Westell and Mr. Cooper does not present any very unique features. It is a systematic book containing a few coloured and numerous illustrations that are quite good, especially those in colour. A preliminary chapter furnishes hints on collecting, after which an explanation of general systematic and morphological terms leads to the enumeration of species. The salient distinctions of each order are given, and the specific characters are scheduled at the expense of much space. The book is somewhat simpler than a flora, but less complete, as only about 200 species are described.

ELEMENTARY PHYSICS.

(1) *First Year Physics.* By Charles E. Jackson. Pp. vii+112. (London: Methuen and Co., n.d.) Price 1s. 6d.

(2) *Einführung in die Elektrochemie.* By Prof. W. Bermbach. Pp. iv+140. (Leipzig: Quelle and Meyer, 1907.)

(3) *Magnetism and Electricity and the Principles of Electrical Measurement.* By S. S. Richardson. Pp. viii+596. (London: Blackie and Son, Ltd., 1908.) Price 5s. net.

(1) THIS small manual is intended as a first-year text-book for schools where three or four hours per week are devoted to the subject. The book is divided into two portions; the first, theoretical, and consisting of about 100 pages, deals with units of measurement, length, area, volume, density, pressure, and force. The second part consists of 76 laboratory exercises bearing on the subject-matter of the first portion. In addition, examples for home work are given at the ends of each chapter. The book is written in clear and simple language, and the illustrations are good. The section on "Mixtures," p. 51, is ill-chosen. A theoretical calculation of the density of a mixture as there indicated will most probably differ from that obtained practically by the pupil, owing to change in volume on mixing. Again, good practical results cannot be obtained from the pendulum experiments if carried out according to the directions indicated on p. 85, viz.:—

"Allow the pendulum to swing through an arc of about 3 in. long and measure the time of 10 *complete swings*, using a watch with a seconds' hand for this purpose. . . . Repeat taking 20, 30, &c., swings, and from each measurement calculate the time of one swing. The result in each case should be the same."

Again, in section 136 we are told to time 20 swings when investigating the variation of period with length, and as an example 1.42 sec. is given as a period calculated from such an observation.

(2) The title of this book is somewhat misleading, as it does not deal with the applications of electrical methods to chemical industries, but is intended as an introduction to the study of physical chemistry. Although the treatment is of an elementary nature, the book may be profitably read by students of physics and chemistry. The first chapter is devoted by the author to a *résumé* of the laws and principles of electricity; the second chapter contains the fundamental conceptions and definitions on which the science of physical chemistry is based. The remainder of the book deals with such subjects as the electrolytic dissociation theory of Arrhenius, osmotic pressure, conductivity of electrolytes, migration of ions, and the theory of the voltaic cell. References to more advanced works on the subject are given at the end of the book.

(3) This text-book assumes a knowledge of the elementary descriptive portions of magnetism and electricity, and is intended for those students who are pursuing the subject further, either as a branch of pure physics or in preparation for a course of applied electricity. The author does not assume more than an elementary knowledge of the principles of trigonometry and mechanics in dealing with the subject. The treatment, on the whole, is very clear and concise, and the book contains considerably more matter than is usually found in books of this standard. Solutions of many questions set in recent examinations are included in the text, or given as examples to illustrate the subject-matter. These will, no doubt, commend the book to many students preparing for examinations. The statement on p. 27, "When the lines of force are parallel the field is of uniform strength," is not a very intelligible way of defining a uniform magnetic field for an elementary student. Again, on p. 97, "If a conductor carrying an electric current is placed in a magnetic field it is subject to a mechanical force which depends on the length of the conductor, the current strength, and on a measure of the field," is a somewhat loose statement, there being no mention of the direction of the field with respect to the conductor. In Fig. 204, on p. 446, "Measurement of Thermoelectric Force," the connections are apparently wrong, although the author gives no explanation of the various parts of this figure.

OUR BOOK SHELF.

Text-book of Physiological Chemistry, in Thirty Lectures. By Emil Abderhalden. Translated by William T. Hall and George Defren. Pp. xiii+722. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 21s. net.

WHEN Prof. Abderhalden's book was published in German about two years ago, its general excellence was at once noted, and it stepped immediately into the front rank of text-books which deal with this important and rapidly growing branch of physiology. Its author had already made for himself a great reputation as an original investigator, and as Prof. Emil Fischer's chief lieutenant had done much to elucidate the fundamental question which lies at the root of biochemistry, namely, the constitution of the protein molecule. In spite of

being a prolific worker, he has found time to write a text-book, and in so doing has established for himself another reputation as a clear and thoughtful exponent of the things the student should know. Copious references to the bibliography of the subject enhance the value of the work.

Books on physiological chemistry, or biochemistry, as it is the fashion just now to term it, have been very numerous of late. This merely indicates how assiduous are the disciples of this department of science at the present day. It was inevitable, however, that Prof. Abderhalden's book should receive the honour of translation into other tongues, and all will welcome its appearance in English dress. The translators have carried out their task with great skill, and have successfully preserved the lucid style of the original. The difficulty of international nomenclature in science is always with us, but is perhaps nowhere so conspicuous as in chemistry. Even in the English language there are no fixed rules, and such rules as do exist are often more honoured in the breach than in the observance. The Chemical Society of London has formulated laws on this question, and we believe that the American Chemical Society has acquiesced in them. There is therefore some hope for uniformity in the future, and it is gratifying to find in the present translation that these rules are observed.

In reference to protein nomenclature, a joint committee of the Chemical and Physiological Societies recently issued a report, and as the main recommendations have been also adopted by the corresponding American societies there is again some hope that authors may see their way to adopt them also, and so do something to bring order out of chaos. The translation of Prof. Abderhalden's book, however, had gone to press before this report was issued, so that in certain points (for instance, the retention of the term nucleoalbumin) the old confusion is perpetuated.

But, as the translators wisely say in their preface, it seems probable that in view of the rapid progress which is being made in this branch of chemistry, before long we shall be able to adopt a chemical classification of the proteins which will be better than any yet proposed. W. D. H.

Double Star Astronomy. Containing the History of Double-star Work; Computation of Orbits and Position of Orbit Planes; Formulæ in Connection with Mass, Parallax, Magnitude, &c. By T. Lewis. Pp. 40. (London: Taylor and Francis, 1908.) Price *2s.*

WE doubt if Mr. Lewis has done himself justice in this little work, by which is meant that anyone might read the pamphlet and fail to recognise that he was in presence of a master. Within the small limits to which he has confined himself, it was impossible for the author to discuss the subject with the fulness it demands or the completeness that his experience would approve. He is our authority on double-star work. His familiarity with the subject has been abundantly demonstrated, his researches have been thorough and minute, and his success has been pronounced. We do not forget that here he is writing for amateur astronomers, who particularly affect double-star observation, and to many of whom the past history of astronomy is a blank. These will welcome the historical notes showing what has been accomplished, and by what means our knowledge has been enriched.

From history the author passes to computation, and we can sincerely hope that, guided by the excellent practical methods clearly set out, and illuminated by examples, many observers will be tempted to advance a step beyond mere observation. Of course, the information necessary for computing a new or correcting an approximate orbit increases but slowly, and opportunities may not very readily offer. It is perhaps more desirable that an observer should be able to compare his measures of position angle and distance with the places deduced from known elements. These means are provided and illustrated here, and by using them the observer will learn whether it is worth while to continue his measures of a particular star or to remove it from his working list, because he will see not only whether there is a wide discrepancy between the measures and the computed places, pointing to the necessity of correcting the elements, but whether the position of the companion is moving so rapidly as to demand frequent measures. In a word, the student of this little book will be able to observe more intelligently, more usefully, and with greater delight to himself.

The Threshold of Music. By Dr. William Wallace. Pp. xii+267. (London: Macmillan and Co., Ltd., 1908.) Price *5s.* net.

DR. WALLACE has endeavoured in these pages to trace the development of the musical sense in the human race from the earliest ages up to the present time, and to trace its relation to the development of thought in other directions. In the chronological chart which is appended he "represents graphically in a diagram" the lifetimes of the principal composers on the scale of one millimetre to the year, side by side with those of men eminent in science, literature, and art. No one will doubt the author's main contention that the development of modern music has taken place according to the natural laws of ev lution, and a book written with this object, though admittedly touching only the fringe of the subject, opens up a highly interesting field of study.

Dr. Wallace clearly shows how the old classical ideal found its culminating point in the works of Beethoven, and that the demand for "more expression," or, as we should say, a closer connection between music and other phases of thought, led to the development of the modern school. In our opinion the two schools stand in somewhat the same relation to one another as pure and applied mathematics. Dr. Wallace considers that still higher musical ideals may be attained in the future. But we would suggest that the transition from pure to applied music has been rather the outcome of causes which have involved degeneration from the perfection of form of the older school, just in the same way that the requirements of the practical man involve the use of approximate methods which represent a sacrifice of the perfection of form of the theories of the pure mathematician. It is little to be wondered at that in an age when men's sense of sound is deadened by the perpetual din of electric trams, motor-cars, and typewriters they should be able to endure and appreciate complex minor chords and discords blasted out "fff" or even "fffff" by an orchestra the overtones of the instruments of which afford no approximation to harmonic series, and the chaotic effect of which is further intensified by the acoustic properties of the concert hall.

Vorlesungen über technische Mechanik. By Dr. August Föppl. Vol. v. Pp. xii+391. (Leipzig: B. G. Teubner, 1907.) Price 10 marks.

THE point which strikes an English reader most forcibly on opening this book is that "technical mechanics" in Germany means something much more thorough and scientific than it does in England. Here we have a highly mathematical treatise on the theory of elasticity dealing with the flexure and vibrations of plates, the bending and torsion of beams, including Saint Venant's problem and its solutions for the ellipse, equilateral triangle and rectangle, the latter involving the usual application of Fourier's series,

solutions of the equations of elasticity for cylinders and solids bounded by planes, and numerous other important problems, selected, however, with a view mainly to practical applications. The volume forms a sequel to the third volume of the series, in which the elements of the theory of elasticity are dealt with.

Problems are every day occurring in engineering and naval architecture which require for their solution a knowledge of the subject-matter contained in this book. Very often such problems lead to differential equations, the solution of which, subject to the given boundary conditions, would keep a pure mathematician occupied for years. It is gratifying to learn from the preface that in Germany, at any rate, the larger industrial works are attaching importance to including on their engineering staffs specialists possessing theoretical knowledge of the kind here treated.

A further stimulus in the same direction has been afforded by the somewhat recently instituted degree of Doctor of Engineering. In these circumstances engineering science is bound to progress in Germany, and important new developments and improvements may be anticipated. In England not one man in a hundred who graduates at our universities in mathematics attains the standard of this book, and the majority of engineering students consider that their education in mathematics has reached a very high standard if they *really* understand the meaning of a differential coefficient and a moment of inertia. They practically never get beyond EI divided by Ro.

Fads and Feeding. By Dr. C. Stanford Read. Pp. viii+163. (London: Methuen and Co., n.d.) Price 2s. 6d. net.

THIS is an admirably clear, well reasoned, and sensible little book. One can only hope that it may be widely read and may do something to counteract the ridiculous views on diet which are the result of the cogitation of that dangerous class of people who, having a little knowledge, supply the remainder from their own imagination. In spite of the importance of a suitable diet for health, there is perhaps no other subject which breeds so many fads. These are disseminated without discrimination by the cheap Press, and are assimilated by certain sections of the public who are always on the look-out for the latest new thing in the way of being different from their neighbours.

The key-word of Dr. Read's book is moderation; moderation in meat-eating, in tea-drinking, in the use of alcoholic drinks and the like. He is also moderate in the way he deals with the faddists, the vegetarians, the uric-acid-free dietists, the teetotalers, and the rest. Perhaps this method of dealing with them is the most effectual with the public, who, taken as a whole, are moderate, and temperate too. A reader is always apt to distrust the hammer-and-tongs argument, and to label those who adopt it among the faddists also.

Dr. Read does not concern himself with prescribing diets in disease, that is properly left to the medical attendant; he deals merely with the underlying scientific principles which regulate, or ought to regulate, the diet in health. There are, however, a few useful general hints laid down regarding the foods suitable in dyspepsia and in obesity. The golden rule for diet is to take in moderation the kind of food which experience has shown can be easily digested. The enthusiast who cannot see beyond his one idea is never a safe person to trust in any sphere of life. The accumulated knowledge which is the offspring of experience and physiological experiment is the only sort of knowledge which is trustworthy. It is impossible for every member of the public to wade through physiological treatises; the least one can expect the non-scientific man in the street to do is to study such a book as the one under review, in which this mass of facts is boiled down and presented in a non-technical and palatable form. W. D. H.

Uber Nervöse Dyspepsie. By Georges L. Dreyfus. Pp. iv+102. (Jena: Gustav Fischer, 1908). Price 2.50 marks.

ALTHOUGH this work of 100 pages claims to be a collection of psychiatric researches from the Medizinische Klinik at Heidelberg, it is of the nature rather of a critical digest than an attempt to add much to our knowledge of the subject with which it deals. The researches consist of careful investigation of twelve patients suffering from nervous dyspepsia, including the chemical analysis of the gastric contents after the administration of test-breakfasts. The cases are carefully recorded.

After a historical introduction the author proceeds to consider cases of dyspepsia in which mental disease, nervousness, hysteria and acquired neurasthenia are to be regarded as the primary cause and he rightly insists that the nervous disorder in these patients is not due to the dyspepsia; but he does not point out, as he should have done, that some rare cases of nervous disorder occur as the direct result of chronic dyspepsia of stomachic origin, and that in other cases dyspepsia and nervous disease have a common cause and are not dependent on one another. This view ought to be considered in dealing with acquired neurasthenia which is, according to some writers, probably due to the accumulation of fatigue products. The dyspepsias of Addison's disease and of exophthalmic goitre are mentioned, as well as cases in which degeneration of the plexus of Meissner was found *post mortem*.

In his summary Dr. Dreyfus maintains with justice that nervous dyspepsia is a symptom and not a disease, and that, although we are ignorant of the intimate physiology of the condition, we are in a position to assert that local treatment of the stomach by modifications of diet and other means is useless. In other words, the disease, and not the symptom, must be treated.

The bibliography of 10 pages is very full, so far as German work on the subject is concerned, and contains some references to papers in other tongues.

The volume, which is well written and easy of reference, will be welcomed by future workers on dyspepsia due to disease of the nervous system.

The Metaphysics of Nature. By Prof. Carveth Read. Second edition, with appendices. Pp. xiii+372. (London: A. and C. Black, 1908.) Price 7s. 6d. net.

AMONG the ways in which this edition differs from the first issue may be mentioned the fact that a preface has now been provided, and this introduction is of special interest as revealing the way in which Prof. Read himself regards his book, and his opinion of the reviews of the first edition. Referring to the nature of the work, the preface states:—"It is not a deductive system from principles, advancing from the simple to the complex, from the general to the particular, or according to some such formula; but is everywhere a reflection upon experience in the light of common-sense. It starts everywhere from the facts, and these may not have a necessary order." To elucidate further the more important doctrines of the book, the author has added in this edition appendices on truth, consciousness, transcendent being, and moral freedom. Unfortunately, no index is provided.

The Reliquary and Illustrated Archaeologist. Edited by Rev. Dr. J. Charles Cox. New series, Vol. xiv. Pp. 302. (London: Bemrose and Sons, Ltd., 1908.) Price 12*s.* net.

THE quarterly numbers of this review are often noticed separately in these columns on their appearance. The *Reliquary* is devoted to the study of the early pagan and Christian antiquities of Great Britain, mediæval architecture and ecclesiology, the development of the arts and industries of man in the past ages, and the survivals of ancient usages and appliances in the present. The volume for the present year contains an abundance of interesting text and excellent illustrations, and should appeal to a wide circle of readers interested in antiquities.

The Class-room Atlas of Physical, Political, Biblical, and Classical Geography. Edited by E. F. Elton. Third edition, revised. Pp. vii + 48, plates + 11. (Edinburgh and London: W. and A. K. Johnston, Ltd., 1908.) Price 5*s.* net.

THIS widely known atlas has undergone a thorough revision, and may be recommended to the careful attention of teachers in schools where geography is regarded as a school subject of great educational value. The editor has been successful in his aim of providing clear maps, a full treatment of physical features, and a series of climate charts which will meet school requirements adequately.

Flashes from the Orient, or a Thousand and One Mornings with Poesy. In Four Books: Spring, Summer, Autumn and Winter. Book second—Summer. By John Hazelhurst. (London: Hazell, Watson and Viney, Ltd., 1908.) Price 1*s.* 6*d.*

MR. HAZELHURST draws the inspiration for most of his verse from natural objects and phenomena, but occasionally current events, incidents relating to people of the day, and moral questions form the subjects of his sonnets. There are many evidences of the author's versatility in the 205 pieces the book includes, and his imagination and grace will please many readers.

The Country Home. Vol. i., May to October, 1908. Pp. ii+380. (London: Archibald Constable and Co., Ltd., 1908.) Price 5*s.* net.

THE first volume of this very attractive magazine, containing the monthly numbers one to six, is likely to become a popular book in country houses. Nature-study takes a prominent place in the comprehensive table of contents, and much attention is given to horticulture and other suitable pursuits for country dwellers. The illustrations are numerous and good.

LETTER TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Objective Demonstration of the Rotation of the Plane of Polarisation of Light by Optically Active Liquids

SOME years ago a method was described by N. Umow (*Zeitschrift für physikalische Chemie,* 1899, xxx., 711) for demonstrating objectively the rotation of the plane of polarisation of light by an optically active liquid such as a solution of sugar. The method was an ingenious application of Tyndall's experiment on the effect of an opalescent liquid on a beam of polarised light. It consisted in rendering a concentrated solution of sugar somewhat turbid by adding to it a small quantity of an alcoholic solution of resin; on passing an intense beam of plane polarised light into this solution spirals of light of the spectrum colours were seen round the walls of the tube, the colours being, of course, due to rotation dispersion.

Some time ago, in order to show this phenomenon, I made a slight modification of Umow's method in regard to the solution, which appeared to be advantageous. A concentrated solution of sugar was mixed with arsenious oxide, and when as much of the latter had dissolved as possible, the liquid was filtered, and sulphuretted hydrogen gas passed through the filtrate. This gave a clear solution of sugar and colloidal arsenious sulphide, and when an intense beam of plane polarised light was passed into such a solution the phenomenon described by Umow was very clearly seen, although some of the colours were slightly interfered with by the yellow colour of the solution.

For the purposes of a popular lecture I recently prepared a colloidal solution in water of arsenious sulphide alone—to exhibit the Tyndall effect—and another as above described, but I also filled a third tube with a solution of sugar in water (made with tap-water and filtered through ordinary filter paper). I proposed to point out that a beam of plane polarised light passed through this last tube should produce no effect, as the tube contained a true solution.

On trying the experiment beforehand, however, I was surprised to find that the colours were nearly as distinct as, and certainly purer than, in the case of the solution which contained arsenic sulphide. It thus appears that in order objectively to demonstrate optical rotation nothing further than a clear aqueous solution of sugar is necessary, and that Umow's addition of resin and mine of arsenious sulphide were superfluous.

It seems highly probable that the simple experiment of passing a beam of plane polarised light sufficiently intense to show the phenomenon can never have been made before, otherwise the experimenter could not have failed to be struck by the colours produced.

As regards explanation, there seem to be two possibilities:—(1) there may be in the solution containing sugar and water a small quantity of foreign matter, either in the colloid form or in such a fine state of subdivision as to pass through the filter paper, these particles, as in Tyndall's and in Umow's experiment, scattering light and thus showing up the rotation; or (2) the spirals may be due to scattering of light by the sugar molecules themselves, which thus serve to show up their own rotation. The decision must be left to those competent to discuss the question. I will only mention in support of the first suggestion that when a beam of ordinary light is passed through the aqueous sugar solution slight scattering of the light certainly occurs, as is shown by examination of the light coming from the sides of the tube, by means of a Nicol prism. On the other hand, however, the colours seen in the tube containing sugar and water alone are but little inferior in intensity to those seen in the tube containing arsenious sulphide.

I have also passed a beam of plane polarised light through a tube containing a very pure specimen of menthyl acetate ($[\alpha]_D^{16\cdot 6} = -79^\circ\cdot 5$) which had been carefully distilled. The colours were quite apparent in this case also, being purer, but not so intense as with the sugar solution. The scattering of ordinary light by the menthyl acetate was very slight indeed.

Whatever the cause of the phenomenon may be, it is a very simple matter to demonstrate objectively to a large audience the rotation of the plane of polarisation of light.

T. S. PATTERSON.

Organic Chemistry Laboratory, University of Glasgow, December 18.

THE FINANCIAL STATUS OF THE UNIVERSITY PROFESSOR.[1]

THE Carnegie Foundation for the Advancement of Teaching was instituted for the betterment of the calling of the teacher in the United States, the Dominion of Canada, and Newfoundland. Its first

1 "The Financial Status of the Professor in America and in Germany. Bulletin No. 2 (New York: The Carnegie Foundation for the Advancement of Teaching, 1908.)

"The Relations of Christian Denominations to Colleges." An Address before the Conference on Education of the Methodist Episcopal Church, South, at Atlanta, Ga., May 20, 1908. By Henry Pritchett, President of the Carnegie Foundation. (Printed at Nashville, Tennessee, 1908.)

purpose has been to establish an efficient system of retiring pensions for professors in the higher centres of learning. Up to May, 1908, sixty colleges and universities had been admitted to the benefits of its retiring allowance system, and one hundred and six professors and eighteen widows of professors are already receiving allowances amounting in the aggregate to more than 37,000*l.*

A natural sequel to this first important task has been the collection of statistics relating to the salaries of the American professors, and a comparison of the figures with those prevailing in Germany. The report which has been drawn up contains an introduction by Mr. Henry S. Pritchett, president of the foundation, while the arrangement and analysis are due to Prof. E. L. Thorndike, of Teachers' College, and Messrs. John G. Bowman and Monell Sayre, representing the Carnegie Foundation. For the data concerning the German professor, Dr. A. A. Snowden is responsible.

We learn from the report that there are about 1000 institutions in the United States and Canada bearing the title "college" or "university." A great many of these, however, do not rise above the rank of indifferent high schools; roughly speaking, nearly one-half of them are not colleges in any true sense, and the pay of their teachers is proportionately small. As it would be unfair to draw conclusions from these institutions regarding the average pay of the teacher of real distinction, the committee has based its conclusions mainly on information derived from the 102 institutions in the United States and Canada which appropriate annually more than 9000*l.* for the total payment of the salaries of their instructing staffs. The tables indicate that in these institutions the salary of a full professor ranges generally from about 270*l.* to 960*l.* per annum, and that the average is about 500*l.* It is pointed out that the variations in salary correspond to some extent with differences in cost of living, and that while a salary of 400*l.* may be a comfortable one in a small town in the middle west of America, double that salary may not secure equal advantages in New York. It appears that all the salaries below 300*l.* are paid either at colleges where living is comparatively inexpensive, or they are paid under exceptional conditions, in addition to free rooms and board.

From an examination of the corresponding figures for associate professors and assistants, Mr. Pritchett concludes that an American who has taken a postgraduate course and prepared himself for the profession of higher teaching may hope to obtain 250*l.* at the age of twenty-eight, 270*l.* at thirty-one, 450*l.* at thirty-three, and 500*l.* at thirty-five. The report also discusses the details at fifty-four of the most important institutions, where the total annual expenditure varies between 2000*l.* and 9000*l.* It is found that though several of these institutions are doing excellent work as "colleges," it is practically impossible for a "university" to exist and do good work under 9000*l.* a year. The scholarly atmosphere maintained at some of the smaller institutions is in direct relation to the relatively high salaries they pay their teachers.

There are very few large prizes in the teaching profession. In only two or three colleges does the salary rise above 1000*l.*, and it would appear that in several instances those drawing this salary have been appointed under conditions which have since been modified.

Mr. Pritchett is keenly alive to the need for bettering the position of the university teacher. It is pointed out that the professor can never expect to earn the large income which is the reward of enterprise and ability in such learned professions as medicine and law. The attraction which leads able men into the teacher's calling springs from two sources, first, the sense of power and responsibility which the true teacher feels; secondly, the love of study and of the scholar's life. Held in a position of highest dignity by those about him, he lives a life of frugality, of simplicity, of influence, and, above all, of happiness. He lives, as Mr. Lowell observed, in the only recognised aristocracy in America. A man who chooses this calling should be freed from financial worries. A salary below the line of comfort means a struggle to live and educate the children of the family. Probably there are very few professors in any country who do not utilise their salaries to the best advantage by living the simple life, so that when the financial worries come the sacrifice takes the form of abandonment of research and the undertaking of outside work, often remunerated at a rate which makes but a poor return for the demands it imposes on the professor's time. The need of opportunity for research is strongly emphasised by Mr. Pritchett. Another cause which is detrimental to scholarly productiveness is the large amount of administrative and routine work frequently devolving on the teachers.

The second part of the report deals with Germany. The committee finds that the German professor may expect in time a far greater financial and social reward than comes to his American colleague. He has, furthermore, a place of far greater security, and with full protection for his old age and for his wife and children. On the other hand, he has to go through a longer period of probation than the American before attaining the coveted chair. A German who possesses such ability that he may expect in due time to become a full professor, and who prepares himself for university teaching, must expect to study until the age of thirty with no financial return, to study and teach as a privat-docent until nearly thirty-six, with an annual remuneration of less than 40*l.*, and to teach from thirty-six to forty-one with an annual remuneration of from 120*l.* to 400*l.*, by which time he may become a full professor and will continue to receive his salary until his death.

The committee is very strongly of opinion that the low scale of salaries of American professors is in no small measure due to the multiplication of weak and unnecessary colleges, and also to the tendency to expand the curriculum over an enormous variety of subjects without regard to thoroughness. A college of ten professors who are strong teachers, commanding fair compensation and teaching only such subjects as they can teach thoroughly, is, as Mr. Pritchett points out, a far better centre of intellectual life than a college which seeks with the same income to double the number of professors and to expand the curriculum to include in a superficial way the whole field of human knowledge. In many instances given in this bulletin the low grade of college salaries is due to the attempt to maintain a university with an income which is adequate only to the maintenance of a good college.

In regard to the multiplication of classes, it is pointed out, in so many words, that as a rule neither the professors nor the president of a university college are fighting business men. When it comes to a question of asking for more money, they are by nature diffident of placing their own personal claims in the foremost position, and they adopt the "path of least resistance" by associating their demand with some desirable extension of the teaching work of their institution. They hope all along that their own candle will be relieved from the pressure of the bushel which dims its luminosity. But, unfortunately, they

too often adopt a course which has the reverse effect by exhausting the funds which might be theirs if they only asserted themselves with a little more push. It is this fact which has led to a result, not peculiar in any way to American universities, that the salaries of professors often decrease in direct measure as the success of their college or university increases. If Mr. Pritchett had carefully studied the universities of Great Britain he might have found some notable instances in our own country. Meanwhile the professor himself makes strenuous efforts to reduce his butcher's or tailor's bill, and if he succeeds it too often happens that his influence as a leader of thought is impaired in consequence. As the committee puts the matter, he does not feel quite justified in demanding a greater salary for himself, even though he is wasting the university's energy in copying quotations, building fires, and hunting about the town for a cheap tailor. A course is given, though only five out of a thousand students take it, and though these five would probably be as much profited by some other course already offered. Yet to give that course is to withhold an increase of twenty or twenty-five per cent. to some individual's salary. It is pointed out that in many things institutions might profitably cooperate. There does not seem, for example, any necessity for two universities in the same city to give courses in Syriac.

The problem which this consideration presents is thus stated on p. 52 of the Bulletin. Given a certain sum for salaries for a university or college of a given size, how much must be sacrificed in the quality of the teachers in order to have enough teachers? If all the conditions of the problem were capable of exact numerical representation, this would be a simple problem in maxima and minima, but in view of the difficulty of translating the data into mathematical language, we may be at least satisfied with the committee's recommendation that one 600*l.* man teaching a class of thirty-six students probably means better progress than two 300*l.* men each teaching eighteen of the thirty-six.

Turning to the question of multiplication of colleges, an important factor in America has been the foundation of a large number of educational institutions associated more or less directly with certain Christian denominations. These colleges form the subject of Mr. Pritchett's address before the Methodist Episcopal Conference at Atlanta. Colleges which are under the control of a sect, or which require their trustees, officers, or teachers to belong to a specified denomination, are excluded from the benefits of the Carnegie Foundation. Mr. Pritchett pays a high tribute to the work which many of these institutions have done in the pioneer days of American education, but points out the great increase which has taken place in recent years in the expense of maintaining a genuine college on efficient lines, and finds that during the last two decades Christian denominations have found increasing difficulty in meeting those obligations, and the colleges controlled by them have with few exceptions received a meagre and inadequate support. There are three positions which a Christian denomination may take up in regard to education. First, it may say that the maintenance of colleges is necessary for extending and continuing the influence and power of the Church in question. Under this view the responsibility of providing the funds rests with the Church itself. From the statistics given in the paper it is shown that the salaries which denominational colleges provide for their teachers even in the most favourable cases compare very badly with those prevailing in institutions under State or independent control. A further objection to the system is the burden which it imposes on the ministry of begging money for the Church college. It is clear that under such a system burdens have been imposed on the churches which they cannot efficiently bear at the present time. The second view is that a church may claim the right and duty to control educational institutions on the ground of religious fitness. But it is pointed out that the maintenance of sectarian tests does not, as a rule, conduce to the religious fitness of a college; indeed, it has often resulted in a serious lowering of standard, brought about by competition between colleges of rival denominations. The third method is for a religious body to accept openly the view that colleges and universities are furthering the cause of religion generally, and that the cause can best be advanced by a Church if it exerts its best influences on higher institutions in general without reference to sectarian control. Mr. Pritchett considers that such a solution is not only theoretically but practically possible, and that the abandonment of the spirit of partisanship will strengthen the churches by enabling them to appropriate to their own use in the training of their own men the facilities for general education provided in colleges.

On reading these publications we naturally wish that there was some body in England corresponding to the American Carnegie Foundation, the more so as the operations of that body extend to Canada as well as to the United States. The very success of the higher educational movement in Great Britain has too often resulted in a lowering of the professors' salaries. This is particularly unfortunate in a country where a continual struggle for the upper hand occurs between the scholarly ideal and the examination (shall we say?) ordeal. Examinations are not altogether bad in themselves; they test the student's powers of English composition, of expressing lucidly and intelligibly in writing the ideas which he has learnt. They should also test his resourcefulness in dealing at short notice with difficulties which have not been anticipated by the teacher. But the teacher whose tenure of office is at all insecure cannot but feel that in many instances his means of livelihood are more or less dependent on the outside show which his classes make when the numerical results of examinations are compared with those of other institutions. Thus, instead of devoting his spare hours to research, he is often led voluntarily to give private tuition to those members of his classes whose prospects of passing their examinations are doubtful. In other words, a premium is placed upon inferior scholarship. We have known of professors whose careers have been ruined by their too rigid insistence on high scholarship in contradistinction to high records of examination passes. Again, the need of retiring allowances for professors was never and nowhere more acutely felt than it is in Great Britain at the present day. That it should be possible for a Fellow of the Royal Society to be reduced to extreme poverty without even a Civil List Pension, after devoting the best years of his lifetime to the interests of a college, doing the work of perhaps five professors in a German university for a salary far below the line of comfort, is an occurrence of which our country cannot feel proud. To make things worse, this sad misfortune may not improbably have been the result of overwork in undertaking additional administrative duties for the college in a period of emergency. If the Carnegie Foundation does no more for America than prevent the occurrence of such cases its existence will be fully justified, but it would be a great relief to some of us on this side of the Atlantic if a similar institution could be charged with the interests of the higher teachers in Great Britain.

G. H. B.

THE VACATIONS OF A NATURALIST.[1]

THOSE who have read "In Northern Spain," published some years ago, will welcome another book of travel by the same author. In the years 1902 and 1904 he spent the long vacation in the south of Mexico in search of zoological specimens, and the present volume not only gives us an entertaining account of the experiences of himself and his wife in localities which are still but little known, but it is a collection of scientific observations and speculations of considerable value, in which, though zoology naturally takes the first place, other branches of research are by no means neglected. He spent a considerable portion of his time in the *tierra caliente*, the hot tropical lowlands, at a season from June to September—when vegetable and animal life exhibits the greatest luxuriance and activity. It is, however, a period of excessive heat, and in most places heavy rainfall, so that readers of the book will obtain an unduly unfavourable impression of life in tropical America. At other times he was at work on the invigorating table-land of Mexico or the slopes of its lofty volcanoes.

Everywhere he was successful in obtaining specimens of new or rare forms of life, and to those who know the difficulties of carrying through a programme where the bridle-path and mule-train are the only means of transport, the amount that he was able to accomplish in the limited time at his disposal will seem marvellous.

The book commences with a description of the environs of the capital, and gives an interesting account of Lake Xochimilco, famous for its floating gardens and the axolotl that inhabits its waters, the questions which arise in connection with the life-history of the latter being discussed in some detail.

The travellers spent some time on Citlaltepetl, el Volcan de Orizaba, where the author was struck by the abrupt character of the upper limits of plants on the mountain-side. "*Tillandsia tricolor* disappears quite suddenly from the southern slopes at about 9600 feet; the last specimens are just as large and flourishing as those lower down, whilst the conifers upon which they grow, continue without the slightest change. The *Pinus liophylla* and the *Abies religiosa* cease at their upper level as very big trees."

The author obtained five species of the land-newt, Spelerpes, one of which, *S. variegatus*, was ultimately found to extend from an altitude of 9000 feet to the tropical lowlands. He states that "a boxful of *S. variegatus* that he collected in a day's excursion in a tropical region south of Cordoba lived very well on Citlaltepetl in spite of the low temperature, but those brought from that mountain died within a few days when taken into the tropics; and he considers this to corroborate "the fact that most creatures can endure a temporary change into cooler surroundings, even though they may not flourish under it, while the reverse of such conditions prostrates and kills them." It is, however, doubtful whether this is true of warm-blooded animals. On the other hand, he contends that there are many more species of animals and plants, which have their "probable centre of origin in temperate climates, and now extend into the tropics and yet remain apparently unaltered, than there are hot country species which have spread into cool climates."

From Orizaba the travellers passed to the low-lying forests of the Rio Tonto, on the northern side of the Isthmus of Tehuantepec, where a goods van shunted on to a siding formed their headquarters. The author's description of a tropical forest is so true to nature that part of it may be quoted here:—"It does not begin gradually. On its outskirts it is fringed by an impenetrable wall of luxuriant herbage, shrubs and creepers. . . . It can be entered only by hacking and slashing a path through the tangled growth, which closes up again within a few weeks, except where traffic may have produced a narrow, meandering track, from which it is impossible to deviate either to right or left. Once inside, we are in a gloomy, stuffy forest consisting of tall, straight trees, which branch out at a great height above us, there interlacing and forming a dense canopy of green through which passes little or no sunlight. The absence of direct light effectively prevents the growth of underwood, and there are no green, luxuriant plants, no flowers or grass. The ground is brown and black, covered with many inches of rotting leaves and twigs, all turning into a steaming mould. From our point of view below the canopy the leaves, branches, and even bright-coloured birds look black, and this is still more the case where, by contrast, such objects are seen through a rift in the canopy against the glaring sky."

The "Chinampas" or Floating Gardens of Lake Xochimilco. From "Through Southern Mexico."

Prof. Gadow describes in detail the adaptation of different groups of animals to forest life, and lays stress on the fact that, given the same conditions, the outward characters of different forms become almost identical. Speaking of the arboreal Anura, he tells us that "the forests have succeeded so well that it is, for in-

[1] "Through Southern Mexico. Being an Account of the Travels of a Naturalist." By Hans Gadow, F.R.S. Pp. xvi+527. (London: Witherby and Co., 1908.) Price 18s. net.

stance, impossible to distinguish certain green tree-frogs of the African genus Rappia from a Hyla unless we cut them open. If they lived side by side, which they do not, this close resemblance would be extolled as an example of mimicry. In reality, it is a case of heterogeneous convergence brought about by identical environmental conditions. One might almost say that tropical, moist forests must have tree-frogs, and that these are made out of whatever suitable material happens to be available."

Continuing their journey by rail, the travellers reached Tehuantepec, on the Pacific coast, where the lower rainfall is evidenced by less luxuriant vegetation, and thence travelled on horseback north-westward on to the southern plateau. On the way we learn a great deal about a variety of topics, including "white ants"; *Anableps dowei,* the "four-eyed" fish; the weaver bird and the method it has devised of suspending its nests from telegraph wires; humming-birds; rattlesnakes, and how they got their rattle, and the exemplary Chontal Indians, who never steal "porque no es costumbre."

In some places the vegetation consists mainly of cacti. After describing the armament of spines that affords them effectual protection, the author reminds us that "cattle and horses, sheep and goats, were all introduced by the Spaniards, and none of the indigenous vegetable-feeders of the plateau, such as stags, squirrels, hares, and mice, can claim to have helped in the evolution of these plants. Are we reduced for an explanation to go back to the extinct fauna? More likely it is one of those cases in which imagination has run away from a more sober and matter-of-fact judgment. It is, no doubt, the case that the conditions prevailing on a high table-land of this kind, subject to prolonged drought, a fierce sun, great and quickly-succeeding changes of temperature, and dust-storms, have produced the characteristics of this family of plants without regard to the animals." We must remember, however, that the Camelidæ and Equidæ must in all probability have formed part of the fauna of Mexico as late as the Pleistocene, as they are found in deposits referred to that period both in North and South America. Some means of defence against these animals would have been absolutely necessary for the preservation of succulent plants in a dry climate where vegetable food was far from plentiful, and it is only reasonable to suppose that the destruction of unprotected forms contributed to the extraordinary development of spines which now characterises the group.

In the second expedition the author and his wife travelled south from the capital by way of Cuernavaca to the terminus of the railway at Balsas. Thence they made their way on horseback over the mountains to a densely wooded portion of the Pacific coast, where they camped on a narrow strip of dry land between a lagoon and the sea. There is a fine description of the nightly thunderstorm which came up from over the sea, a phenomenon of considerable meteorological interest. Unfortunately, in this and many other cases we are not given the date or even the month when the observations recorded were made, though this information would have added considerably to their value.

The illustrations are plentiful and usually clearly reproduced, though one would have wished for more photographs of the phases of animal life which form such an important feature of the text; but with so much compressed into such a brief period it is easy to understand that there was no time for telephotographic work.

J. W. E.

THE HEADMASTERS' CONFERENCE.

AFTER a school career prolonged to the age of eighteen in one of the great public schools, a youth should possess certain minima of endowment—moral, physical and intellectual. His intellectual assets should include a reasonable proficiency in the use of the English language, the ability to read intelligently at least one other language, a notion of what the study of history really means (with some sense of historical perspective), and acquaintance with some fundamental scientific discoveries, together with an inkling of the importance of the advancement of man's control over his environment. He should have an intellectual interest in at least one subject, not necessarily, nor even preferably, included in his school studies. A charge has been preferred against the schools of failing to equip the majority of the young men who leave their ranks with even this modest minimum of mental endowment, and the authors of this charge include men whose experience and ability lend weight to their indictment. Interest in the headmasters' debates concerning curricula should not at this juncture be confined to the ranks of the scholastic profession.

There were fifty-two headmasters present at the meetings of the conference, which took place at the Merchant Taylors' School, London, on December 22 and 23. The Rev. Dr. Nairn presided, and the larger schools were well represented. It may be well to remind our readers that by its constitution the conference limits its membership to headmasters of schools where a considerable number of boys remain until the age of eighteen or nineteen. A discussion of the proceedings of the annual congress should throw light on the progress being made towards an improved curriculum.

Special interest attaches to the resolutions relating to the age at which the study of Greek should begin. Two years ago the conference declared that this study should be postponed to the age of thirteen or fourteen, and that Greek should not be a subject of the entrance examination at the schools represented in the conference. Forty-two of the leading schools regulate the admission of boys from the preparatory schools by an examination entitled "Common Examination for Entrance to Public Schools." We find that only five of the forty-two schools have definitely dropped Greek, the remaining thirty-seven disregarding the 1906 resolution. On the other hand, seventeen schools exclude science, and the remainder make science optional, usually as an alternative to Latin verse. The practical result is that many little boys in preparatory schools are specialising in classics, and their general education is impossible. In other cases we find (to quote Mr. R. C. Gilson, of Birmingham) "the present stupid method of trying to teach three foreign languages together to little boys in knickerbockers." At the age when the observation of nature and education of motor-centres are of special importance, the public schools insist on the pursuit of Latin and Greek to the practical exclusion of manual and observational training. It is hardly to be wondered at that, to quote Mr. Gilson again, "in the name of teaching Greek the schools were turning out men who could not observe nature." This state of affairs will be remedied to some extent if and when practical effect is given to the resolutions of the conference, which affirmed (1) that the average boy cannot undertake the study of more than two languages besides English before the age of thirteen years without detriment to his general education; (2) it is the duty of public schools to provide classes in which the study

of Greek can be *begun*. There is the more reason for hope that the opinions of the conference will not again be ignored in practice, since the meeting further resolved, on the motion of Dr. Lyttelton, to appoint a committee to confer with the preparatory schoolmasters as to a scheme of studies for schoolboys from the age of nine until about sixteen.

A report presented to the Leicester meeting of the British Association contained recommendations which have been endorsed during the last fifteen months by various meetings of teachers. Without undue precipitancy or rash precision, the meeting decided, "That this conference, while withholding its assent to many details, and in particular to the proposal to postpone the study of Latin to the age of twelve, approves of the main conclusions of the report of the committee of the British Association Education section." It may be hoped that influential headmasters will find some means of translating this approval into action, especially the much-needed improvement of the position of teachers.

Several administrative problems were discussed. The Board of Education was asked to proceed at an early date with the registration of teachers, the suggestion being made that the Registration Council should include representatives of various types of schools. A resolution welcoming the inspection of non-local schools by the Board failed to pass, the previous question being voted by a small majority. Some headmasters desired inspection as a means of bringing the authorities of the schools into closer touch with the Board, in order that the great public schools might take their place in a coordinated system of national education. On the other side, fear was expressed lest compulsory inspection should make the headmaster responsible to two masters, the governors and the Board; any action was deprecated which would diminish or destroy the variety of type of the secondary schools of England. As opinion on this matter appears to be uncrystallised, we may hope that there may be a gradual growth in the number of schools which seek inspection by the Board on their individual initiative. The conference appointed committees to confer with (*a*) the Army Council, (*b*) the Oxford and Cambridge joint board. The neglect of German was deplored, and a resolution was carried in favour of dividing the emoluments of entrance scholarships so that the bulk of the money should be reserved to those in need of financial assistance.

Reviewing the deliberations of the conference as a whole, it can hardly be asserted that the need for far-reaching reform of the public-school curriculum has been sufficiently impressed upon headmasters. Reform of the common examination for entrance to public schools is a necessary preliminary. In its present organisation this examination discourages manual training, ignores the æsthetic side of education, and penalises nature-study and experimental science. The plain teaching of physiology concerning the development of the brain and of neuro-muscular systems receives contemptuous disregard. There is a widespread belief that the position attained by a boy on entry to the public school depends almost entirely on his knowledge of the rudiments of Latin and Greek. We do not know of how many schools this is true, but we are certain that proficiency in natural history or physics should be no bar to a boy's efforts to win a good position, and that no implication of intellectual inferiority should attach to the science side of the school. With great earnestness we urge the joint committee of the conference and the masters of preparatory schools to re-model the conditions of the entrance examination, so that young boys may pursue a broad general course, comprising literary, scientific, mathematical, artistic and manual training. The terms of reference assigned to the committee encourage us to hope for a curriculum containing the studies we have enumerated up to sixteen years of age. If schemes founded on such a basis were adopted by the schools, a partial specialisation during the last two years at school would be compatible with the aim which headmasters no less than their critics have in view, viz. to ensure that the majority of boys should receive during school-life a general education in harmony with the ideas and requirements of the present century.

G. F. D.

BIRDS IN RELATION TO AGRICULTURE.[1]

DURING the past few years birds have received an increased amount of attention, for it has become more generally recognised that the whole question of their food supply is of great importance to British agriculture—using this term in its widest sense. There are plenty of individuals who rightly recognise that many of our avian fauna are of much economic value, while there are also, unfortunately, a far greater number who thoughtlessly stigmatise the majority of birds—or at least birds of a certain class, *e.g.* owls—as useless and harmful. These less enlightened sons of the soil need showing that the majority of British birds are useful, but the showing is far from easy. It has been demonstrated over and over again that the sparrow, or "the avian rat," as Mr. Tegetmeier terms it, is entirely harmful; Yarrell has stated that the kestrel principally subsists on mice; a case is mentioned by Macgillivray in which food was brought to the nestlings by a pair of flycatchers no fewer than 537 times in a day; and the writer has himself observed a single starling carry food to its young from a grass paddock 18 times in 15 minutes; and hundreds of similar records have served to demonstrate in some sense that many birds are useful, and confer an immense benefit on mankind.

Although individual records are very valuable, they are not of the same importance as a coordinated and duplicated set of records, and the latter has been sorely needed. Mr. Robert Newstead has just made a most important contribution to our knowledge of the food of birds, his memoir on the subject being published as a supplement to the December issue of the *Journal of the Board of Agriculture*. As curator of the Grosvenor Museum, Chester, a large number of birds passed through Mr. Newstead's hands, and he was wise enough to tabulate carefully the contents of stomachs, &c. No special effort was made to collect material, and for this reason the records are, perhaps, the more valuable, since no selection of birds "caught red-handed" was made.

Full notes were also made as to sex, locality, date, &c., and the records are based on 871 *post-mortem* examinations of the stomach contents and the "pellets" or "castings" of 128 species of birds. Field observations bring the records up to more than 1100. The contents of stomachs, "pellets," &c., are arranged under several heads, including insects, divided into beneficial and harmful in their respective orders; animals other than insects, *e.g.* slugs, birds, fish and other "small deer"; and vegetable food, which includes fruit, weed seeds, grain, &c. The birds themselves are finally divided, on the results of their partiality for given foods, into seven classes, from wholly innoxious and more or less strictly

[1] "The Food of Some British Birds." By Robert Newstead. *Journal of the Board of Agriculture*, December supplement. (Board of Agriculture and Fisheries, 4 Whitehall Place, S.W.) Price 4*d*. post free.

beneficial, through other grades to wholly destructive and useless species.

Coming now to the results, it is shown that insects were found in 41 per cent. of the total *post-mortem* records and pellets, while if certain birds—*e.g.* finches, owls, hawks, and water birds—are omitted "the insects forming the whole or part of the dietary of the remaining birds amount to between 70 and 75 per cent."

Large numbers of injurious insects were taken by all kinds of birds, click beetles and their larvæ (wire-worms), weevils, crane flies and their larvæ (leather jackets), surface caterpillars and winter moth caterpillars being numerous; for example, five specimens of the rook contained between them 213 surface caterpillars, and 120 winter moth larvæ were found in a jay's stomach.

Grain occurred in about 77 cases, but in almost negligible quantities, and, except in the case of the blackbird and of fruit buds damaged by the bullfinch and blue titmouse, cultivated fruit was scarcely represented. Noxious weed seeds were taken by many birds.

Of the birds themselves, the majority come under the "useful" class; the song thrush, great and blue tits, greenfinch, chaffinch *and rook* have the balance of utility in their favour; the blackbird, bullfinch, sparrow-hawk and raven are destructive and doubtfully of any utility; while it is noteworthy that those species regarded as "wholly destructive and useless" number but three the carrion crow, house sparrow and wood pigeon, the food of the two latter, however, not being considered.

Mr. Newstead's paper should be widely read, for it may certainly be held as a vindication of the bird world, and it is easy to understand the author's emphasis of the great value of the majority of birds. As hinted in the official preface, it is to be hoped that further reports will be forthcoming at a later date.

NOTES.

THE most disastrous earthquake in Europe for many years was experienced in Calabria and the district of Messina, in Sicily, on Monday, December 28. The shock occurred at 5.20 a.m., and was followed by a great sea-wave, which appears to have destroyed Messina and Reggio, and also the greater part of the villages on each side of the Straits of Messina. Reports from Catanzaro state that the first intimation of the disturbance was a prolonged, thunderous noise followed by a vivid flash of lightning, and at the same time by a series of violent shocks which seemed interminable. Heavy torrential rain then fell, and continued to fall during Tuesday. According to reports from *Times* correspondents, so complete has been the destruction of Messina that it is almost impossible to obtain any connected account of the character of the earthquake. The centre of the disturbance seems to have been in the Straits, and it is greatly feared that the whole conformation of the neighbouring coast-line has been changed. On Tuesday, the officer of a torpedo-boat who left Messina for Reggio sent after a few hours the following message:—"I cannot find Reggio; if it exists, it is no longer where it was." The lighthouses in the Straits have been rendered useless by the earthquake, and it is rumoured that the configuration of the bottom of the Straits has been altered greatly. It is estimated that the number of deaths will reach the terrible total of 100,000, for in Messina alone 50,000 lives are said to have been lost. It will be recalled that the province of Calabria was visited with like disasters in September, 1905, and October, 1907.

A TOUCH of real winter has set in over Great Britain since Christmas, and the closing days of December will be remembered for the heavy falls of snow and the severe frosts which have occurred. At Christmas a cold but dry easterly wind was blowing over the whole country, but on December 27 a shallow disturbance traversed the northern portion of the kingdom, and a fall of snow was generally experienced. The heaviest fall occurred in Scotland, but the amounts were fairly large over England, the fall being generally augmented on the following days, and much inconvenience was occasioned on our railways and to other traffic. The frost was exceptionally keen in all parts of Great Britain, and unusually low temperatures occurred in many places. The lowest thermometer readings were mostly experienced on the night of December 28 and on the following day. At Oxford the thermometer on the grass registered 14°, and at Greenwich a similar thermometer read 17° on the early morning of December 29. Much snow has fallen in London and the suburbs, and in St. James's Park, the observing station of the Meteorological Office, the sheltered thermometer stood at 22° at mid-day on December 29. The Greenwich records for the past sixty-eight years only show three instances of the highest day temperature below 25° in December; these occurred in 1855, 1874, and 1890, the lowest previous record being 23°.2, in 1855. Intense cold has occurred generally over western Europe, the minimum thermometer in the screen registering 3° at Berlin and 5° at Brussels on the night of December 28. This severe weather was accompanied by high easterly winds in many places.

WE learn with deep regret of the death of Dr. J. M. Pernter, director of the Zentralanstalt für Meteorologie und Geodynamik in Vienna, and professor of terrestrial physics in the university there. Dr. Pernter died on December 20 at Arco, in South Tyrol, at sixty years of age.

THE Weekly Weather Report just issued by the Meteorological Office gives a summary of the observations for the past year. The highest shade temperatures for the several districts range from 91° in the west of Scotland to 81° in the north of Scotland and in the north of Ireland. The lowest temperatures range from 10° in the east of Scotland and in the Midland counties to 19° in the north of Scotland and 24° in the English Channel. The mean temperature was not generally very different from the average, but there was mostly a slight excess. The number of rainy days ranged from 252 in the north of Scotland to 167 in the south-east of England, and they were mostly in fair agreement with the normal. The largest aggregate rainfall for the year was 51·14 inches, in the north of Scotland, which is 1·17 inches less than the average; the next largest measurement was 46·85 inches, in the west of Scotland. The largest total in the English districts was 36·36 inches, in the north-west, and the least 20·14 inches, in the north-east. The rainfall was nearly everywhere in defect of the average; in the south-west of England the deficiency was 6·93 inches. The duration of bright sunshine varied considerably in different parts of the kingdom, the largest amount being 1897 hours, in the English Channel district. In the south-east of England there was the greatest excess, the total duration being 1737 hours, which is 140 hours more than usual.

WE regret to see the announcement of the death of Dr. George Gore, F.R.S., at eighty-two years of age.

ACCORDING to a Reuter message, the newspapers of Burgos report that five meteoritic stones, weighing from

one to seven kilograms, fell a few days ago in the village of Jubilla del Agua, setting fire to a farm.

Dr. Harold R. D. Spitta, assistant lecturer on bacteriology and lecturer on clinical pathology at St. George's Hospital, has been appointed to the newly created post of bacteriologist to the Royal Household.

According to the *Scientific American*, the U.S. War Department has considered the advisability of immunising soldiers against typhoid fever by vaccination. It has decided that inoculation as a preventive against typhoid has been demonstrated so thoroughly, and its efficacy so well established, that the vaccination method is to be adopted in the United States Army.

We learn from *Science* that an investigation into the cause of cancer, and its possible prevention and cure, has been begun in the College of Physicians and Surgeons, Columbia University, under the direction of a committee consisting of Dr. S. W. Lambert, dean; Prof. W. J. Gies, professor of biological chemistry; Prof. P. H. Hiss, jun., professor of bacteriology; Prof. F. C. Wood, professor of clinical pathology; Prof. G. N. Calkins, professor of protozoology; and Dr. Eugene H. Pool, instructor in the department of surgery.

The American National Association of Audubon Societies is organising a complete census of the game and forest birds of the country. This work will be superintended by a committee consisting of Mr. W. Dutcher, president of the association; Mr. E. H. Forbush, ornithologist of the Massachusetts State Board; Mr. T. Gilbert Pearson; Mr. Frank M. Chapman, assistant curator at the American Museum of Natural History; and Dr. T. S. Palmer, of the U.S. Biological Survey. Thousands of question forms are to be sent to friends of the association throughout America, as well as to all wardens and officials who have opportunities of observing the bird life of their own neighbourhoods. The object of the census is to collect cogent evidence of the need of greater protection for the nation's birds, especially in the interests of the crops and the trees.

The following are among the prizes awarded by the Paris Academy of Medicine for 1908, announced in the *British Medical Journal*: the Laborde prize (200*l*.), for the most notable advancement of surgery, to Prof. Monprofit, of Angers, for his work on the operative surgery of the stomach; the Theodore Herpin prize (120*l*.) to Dr. Albert Deschamps, of Riom, for an essay on the diseases of energy—general asthenias; the Amussat prize (40*l*.) to Dr. Destot, of Lyons, for a radiographic and clinical study of the wrist and industrial accidents; the Orfila prize (160*l*.) to Prof. Calmette, MM. Boullanger, E. Rolants, F. Constant and L. Massol, and Prof. Buisine, for researches on the purification of water that has been used in towns and of the residual water of factories. The Roger prize (100*l*.) to Dr. Marfan, for his treatise on the feeding of infants; the Saintour prize (176*l*.) to Dr. Émile Sergent, for his work on syphilis and tuberculosis; the Campbell-Dupierris prize (92*l*.) to Dr. Morris Nicloux, for his work on general anæsthetics from the chemico-physiological point of view; the Ernest Godard prize (40*l*.) to Dr. F. W. Pavy, of London, for his work on carbohydrates and their transformation—a physiologico-pathological study with considerations on diabetes and its treatment.

We regret to announce the death of M. E. Stuyvaert, who for many years occupied a prominent position in the Royal Observatory of Belgium. For nearly thirty years he rendered loyal and efficient service to that institution, both at Brussels and in its more recent installation at Uccle. He was one of the Belgian astronomers who took part in the observation of the transit of Venus in 1882, and from that time onward he took the greatest interest in extra-meridional work. He was in charge of one of the equatorials, and was indefatigable in his observation of comets and planets, as well as of eclipses and occultations. The physical appearance of the larger planets was a subject which engaged his attention, and he published several memoirs on the surface markings of Jupiter and Mars. His micrometrical measures of double stars from 1878–96 is a well-known work. In addition to instrumental observation, he paid considerable attention to the subject of meteors and the appearance of the zodiacal light. For some time previous to his death he had been engaged in constructing a large-scale model of the moon, which, unfortunately, is left unfinished.

Mr. H. St. John Gray contributes to the *Times* of December 26 a full account of excavations in the Maumbury Rings Circle, of which he was in charge. This has long been regarded as the site of a Roman amphitheatre, and this view is corroborated by the fact that one of the most interesting discoveries made was that of a stratum of shell fragments, quartz, flint, land-shells, &c., similar to that used by the Romans in other places to fill up uneven patches, to prevent the slipping of the gladiators, and to absorb the blood of combatants. Fragments of pottery also indicate Roman occupation, and one portion of the site seems to have been fortified, holes for stakes cut in slabs of Purbeck limestone having been found at the point where the entrance of the arena was situated. It is interesting to find that this place was occupied by the Neolithic people as a flint workshop. Flint flakes, cores, and hammer-stones were found scattered on part of the site, and the picks made of deer's antlers were obviously the implements by which this early race excavated the remarkable pit whence the rough flints were obtained. This pit is at least 30 feet deep, one of the deepest archæological excavations on record, one of those at Grime's Grave being a few feet deeper. It is much to be desired that a site which seems to have been almost continuously occupied since Neolithic times by various peoples should be fully investigated, and it may be hoped that the appeal for help issued by Mr. Gray from Taunton Castle, Somerset, may meet with a liberal response.

A short time ago Dr. O. P. Hay's memoir on the fossil chelonians of North America was reviewed in our columns. The author has supplemented this in No. 1640 of the Proceedings of the U.S. National Museum with an account of four new species, together with a note on a fifth named by Cope.

To No. 5 of vol. viii. of the *Museums Journal* Dr. A. Fairbank, the director, contributes an account, illustrated with plans, of the new building for the Museum of Fine Arts in Boston, U.S.A., which, it is hoped, will be completed early in the new year. Great care appears to have been exercised in the planning of the building, which, it is stated, will be admirably adapted for the display of the treasures with which it is to be filled.

Some time ago Dr. E. Fraas published an account of bones of sauropod dinosaurs obtained by himself in German East Africa. The remains were found lying on the surface of the ground in considerable numbers, and only a portion of those seen appears to have been brought home. With the view of securing additional specimens, Dr. Fraas

we are given to understand, is about to make another expedition to East Africa.

A BEAUTIFULLY coloured plate, in addition to several others in black and white, illustrates a further report, by Mr. R. W. Sharpe, on the ostracods in the United States National Museum, published as No. 1651 of the Proceedings of the Museum. No. 1054 of the same publication is devoted to amphipods collected off the west coast of North America, which include a new family, together with several new genera and species. Mr. S. J. Holmes is the author of this communication.

A FURTHER account of fishes of the Irish Atlantic slope forms the subject of Irish Fisheries, Scientific Investigations, 1906, part v. (1908). The authors, Messrs. Holt and Byrne, commence in this issue an illustrated account of the more uncommon deep-water fishes of the Atlantic coast, with the object of rendering the species easily identifiable by fishermen, and commence with the families Scorpaenidæ and Alepocephalidæ, of which a number of representatives are figured. This is followed by an account of recent additions to the marine fish-fauna of the British Isles, these including a new species of ray.

THE greater portion of vol. xii., part ii., of the Transactions of the Leicester Literary and Philosophical Society is devoted to an illustrated account, by Mr. A. B. Harwood, of the town museum, of the fossil flora of the Leicestershire and South Derbyshire Coalfield, with especial reference to the evidence it affords with regard to the age of the local Coal-measures. It is concluded that the Coal-measures of the Ashby, or central, district are lower in the series than those of the eastern and western districts, which belong mainly or wholly to the middle portion of the series.

THE opening article in the November issue (vol. ii., No. 8) of the *Anatomical Record* is devoted to the methods of teaching anatomy in the medical schools of the United States, more especially at Johns Hopkins University. The importance of concentrating elementary teaching is strongly insisted upon by the author of the paper, Mr. F. P. Mall, this, as applied to anatomy, meaning that the elementary work should be given during the student's first year, the schedule being so arranged that the greater part of the time of each pupil is devoted to this subject until the elementary portion is completed. "It has been the aim of American anatomists," concludes the author, "to elevate the status of our profession, for it has been resting as a compressed buffer between surgery on the one hand and zoology on the other."

REGENERATION at the two extremities of the body in the annelid *Spirographis spallanzanii* forms the subject of the first article, by Mr. P. Ivanov, in vol. xci., part iv., of the *Zeitschrift fur wissenschaftliche Zoologie.* It is stated that in this and allied polychætous annelids, living a sedentary life in tubes constructed by themselves, the phenomenon of regeneration presents a special interest on account of the fact that the bodily structure of these creatures shows several peculiarities, such, for instance, as the abnormally large size of the nephridia in the anterior segments. The regenerated extremities are described in detail in the text, and fully illustrated, both from the external aspect and by means of sections, in the plates.

LIKE many other British birds, the scaup-duck seems to be extending its breeding-range in our islands. According to an account relating to Scotland, given by Mr. P. H. Bahr in the December number of Witherby's *British Birds*, the species was recorded as breeding near Loch Hope in 1834; in 1867 a clutch of ducks' eggs, believed to be those of a scaup, were taken, while in the following year a drake was shot in Sutherland in circumstances suggesting that it was breeding. The first definitely authenticated nest and eggs were obtained in Speyside in 1899, and in 1897, 1898, 1899, and 1900, as well as probably in the two following years, the species bred in the islands south of the Sound of Harris. In 1906 two other nests were discovered in these islands, one of which is figured in Mr. Bahr's paper.

AMONG a number of articles in vol. xxx., No. 1, of Notes from the Leyden Museum, we select for mention one by Mr. E. Jacobson on the construction of the nests of the Javanese ant *Polyrhachis bicolor.* In common with a few other species, these ants spin nests in the leaves of palms and other trees. The example described and figured takes the form of a long and slender tube, slightly expanded at the two extremities, and with a minute entrance at the lower end, its total length being 25 cm. It was constructed in a palm-leaf, and when examined was found to contain one winged female, twenty-five males, twenty-four workers, and a number of pupæ and larvæ in various stages of development. The note concludes with a description of a somewhat more complicated spun nest constructed by the West African *Polyrhachis laboriosa.*

THE embryology and anatomy of hyperdactylism in Houdan domesticated fowls is discussed in great detail by Marie Kaufmann-Wolff in vol. xxxviii., part iv., of *Gegenbaur's Morphologisches Jahrbuch.* The abnormality usually takes the form of an extra digit on the inner side of the hallux or great toe, but in some instances assumes a more complicated type. In the plates and text-figures the structure of the foot is displayed by means of sciographs, dissections, and embryo specimens. Embryology decisively shows that the additional digit or digits arises as a bud from the metatarsal or phalangeals of the hallux, which, in the course of its development, becomes segmented, and eventually appears as a duplication or triplication of the latter. The hyperphalangism is therefore essentially a neomorphic, and in no wise an atavistic, condition, its evidence thus being altogether opposed to the theory of the existence in vertebrates of a prepollex or prehallux.

No. 27 of the "North American Fauna" (U.S. Department of Agriculture) is devoted to an account of the natural history of the Athabasca-Mackenzie region, by Mr. E. H. Preble, based on a recent biological survey of that area. The region is of considerable importance from a commercial point of view on account of the number of valuable fur-bearing animals by which it is inhabited, while it is of special interest to the naturalist as being the one in which the last remnants of the American bison survive in a truly wild state, and it is also the home of the Canadian race of the musk-ox. In the spring, when its springs and rivers are released from the icy grip of the long Arctic winter, the region is likewise the resort of countless flocks of birds of various kinds which breed within its limits, these including representatives, and in some cases the great majority, of most of the migratory game-birds of North America. The monograph, which comprises 564 pages, deals chiefly with the vertebrates, although it likewise contains a section on the trees and shrubs of the district. The explorers were unable to obtain any definite information with regard to the present numbers of the bison, but the herds are stated to be much

harassed by wolves, and the opinion is expressed that unless something is speedily done to reduce the number of the latter, the bison is doomed ere long to complete extermination. Two parties, comprising respectively eight and sixteen head, were reported by the Indians to include no yearlings or two-year-olds, all the calves having been killed by wolves.

IN the December number of *Man* Mr. A. Lang returns to the well-worn controversy on the subject of totemism by a criticism of Dr. Seligmann's paper in the previous number on the subject of "linked totems." He rightly questions the admissibility of the term, and remarks on the confusion between the words "tribe" and "clan" in dealing with the subject. It seems clear that until a recognised terminology comes to be adopted by all writers, the origin and meaning of totemism must remain to a large degree uncertain, and the important problems of its relation to exogamous marriage and prohibited forms of food will continue to be incapable of solution. It may be hoped that in his great forthcoming work on totemism Prof. J. G. Frazer will finally settle the nomenclature of the subject, and thus dispose of difficulties which have led to much wearisome and embittered controversy.

MR. W. K. MOORHEAD, of the Phillips Academy, Andover, Massachusetts, which claims to be "the only preparatory school in the world that possesses a fine museum and department of archæology," has issued two fresh Bulletins, Nos. 3 and 4. The second and more important contains an elaborate monograph on the famous site of Fort Ancient, the great prehistoric earthwork of Warren County, Ohio. It is satisfactory to learn that the State Legislature has now completed the purchase of this important site, which will be preserved as a public park. Needless to say, the age of this monument and its relation to the immense aboriginal cemetery at Madisonville have long formed a subject of controversy among American anthropologists. Mr. Moorhead, who has done much work on the spot, thinks that Fort Ancient may be some eight or nine centuries old, and he dismisses the modern articles found in a grave at Madisonville as "intrusive." It is clear, however, that this *résumé* of the facts at present available will not close the discussion. The writer admits that "we have but begun the right study of the Ohio Mounds," and that it will take many years to complete the field work which is necessary before the problem of their origin and age can be finally solved.

ALTHOUGH the rules and recommendations regarding botanical nomenclature at the Vienna Congress were framed primarily for the guidance of systematic botanists, it is important that they should be generally known. A pamphlet, reprinted from the Transactions of the New Zealand Institute (vol. xl.), gives the substance of an address on the subject read by Mr. T. F. Cheeseman at the Auckland Institute. It provides a good epitome of the salient points, and contains a list of changes caused in the nomenclature of New Zealand ferns. A second contribution to the fuller knowledge of the flora of New Zealand, by the same authority, is concerned mainly with the record of new localities.

INTENDING visitors to Connemara in search of botanical rarities will find it profitable to consult the account of an excursion published in the Transactions and Proceedings of the Botanical Society of Edinburgh (vol. xxiii., part iii.). The two plants, *Erica Stuarti* and *Erica Mackaiana*, that formed the immediate object of the expedition, were obtained. In the same part Mr. W. W. Smith describes a remarkable tussock formation observed in the Scilly Isles, where plants of *Arundo phragmites*, *Pteris aquilina*, and *Carex paniculata* were growing together in clumps, rising as high as 8 feet above the marshy substratum. A short note on the collection of five species of Riccia in the Edinburgh district is contributed by Mr. W. Evans.

AMONG the systematic articles published in the latest part (No. 9) of the *Kew Bulletin*, special interest attaches to the description of a new species of the Burmanniaceæ, *Bagnisia Hillii*, reported from New Zealand by Mr. T. F. Cheeseman. Species of the subfamily to which Bagnisia belongs have been hitherto collected in Ceylon, Samoa, and New Guinea, so that the discovery in New Zealand extends the range considerably further south. Another contribution of considerable interest, more especially to the small cultivator, is the account of a Lancashire willow farm furnished by Mr. W. Dallimore. The willows are grown on dry land under similar conditions to ordinary farm crops; the best twigs are obtained from special varieties of the species *purpurea*, *viminalis*, *rubra*, and *Smithiana*.

WE are in receipt of the recent issues of the *Agricultural News*, a fortnightly paper issued by the West Indian Department of Agriculture dealing with matters of interest to tropical agriculturists. The subject-matter consists mainly of excerpts from various agricultural journals and bulletins, the selection being carefully and intelligently made. Altogether the paper must be ranked among the most useful of our agricultural publications.

THE determination of total solids in sugar-mill products has usually been rather a tedious and uncertain business by reason of the instability of certain compounds in the molasses. Mr. Peck finds that the Abbe refractometer can be used conveniently, and describes the method of working in Bulletin No. 27 of the Hawaiian Sugar-planters' Association. He gives also a set of tables to show the percentage of total solids corresponding with each refractive index. The agreement between the results obtained in this way, and by the older method of drying, is satisfactory, and the method promises to be very useful to sugar chemists.

WE have received from the Board of Agriculture leaflets dealing with gooseberry black-knot (*Plowrightia ribesia*, Sacc.), grain weevils (*Calandra granaria* and *C. oryzae*), and the apple saw-fly (*Hoplocampa* [*Tenthredo*] *testudinea*). They give illustrations showing the pest in its various stages, and the kind of damage it does; there is also a description, in simple language, which will help the practical man in his identification. Schemes of treatment are suggested.

INCREASING attention is being devoted in South Australia to fruit production and to the best methods of placing the products on the market. The *Journal of Agriculture of South Australia* has recently described at some length how fruit-drying is practised in California, where this practice has been developed to a high degree of perfection. The fresh fruit is first fumigated by means of sulphur, then spread on trays and exposed to the sun until dry; but as the weather conditions may become unfavourable, the larger drying grounds are also provided with elaborate drying plant, so arranged that the fruit shall be exposed to a gradually increasing temperature. The tray of fruit is placed in a gently sloping tunnel up which a stream of hot air from a furnace passes, and is gradually pushed downwards as fresh trays are put on behind. This slow

drying is found to give much better results, and to yield a finer product, than more rapid drying would do.

HYDROCYANIC acid is fast becoming a recognised agent for the destruction of various insect pests that infest greenhouses, trees, &c., although the conditions for success are not yet fully known. It is used in combating citrus scales in South Africa, New South Wales, Florida, and elsewhere, with results which, on the whole, are very satisfactory. The fumigation of trees growing in the open air is made possible by covering the tree with a tent. Dr. Morrill recently described in Bulletin No. 76, Bureau of Entomology, U.S. Department of Agriculture, an ingenious graduated tent that not only covers the tree, but also indicates the volume enclosed, thus enabling the operator to use a definite quantity of hydrocyanic acid for each cubic foot of air. The tent is shown in the illustration; it is a large sheet with numbers painted on it in two directions at right angles, starting from the middle. A table has been drawn up showing the proper amount of potassium cyanide to use when any particular numbers mark the base of the tent. The method marks a distinct advance in outdoor fumigation by enabling the operator to avoid an excess of hydrocyanic acid, which would injure the tree, whilst ensuring a sufficiency to kill the pest.

FIG. 1.—Eighty-foot tent covering large seedling orange tree, showing tent graduated for the purpose of enabling operators to use the proper amount of potassium cyanide.
FIG. 2.—Carrying 5-gallon crocks containing acid and water under the tent, preparatory to introducing the cyanide.

THE *Philippine Journal of Science* for September (iii., No. 4) contains several papers of medical interest. Mr. Old reports several cases with unusually severe symptoms caused by stings of an unknown variety of jelly-fish, and Mr. Ruediger describes filtration experiments with the virus of cattle plague which show that the virus is small enough to pass through the pores of the Berkefeld filters V, N, or W, but not through a Chamberland B filter.

IN a second report on research work issued by the Metropolitan Water Board, Dr. Houston, the director of water examinations, details the methods employed and the results obtained in experiments planned with a view to the detection of the typhoid bacillus in *raw* Thames, Lee, and New River waters. The result is that the typhoid bacillus was not once detected. Dr. Houston says, "the most recent tests for *B. typhosus*, applied to a considerable volume of raw river water, at weekly intervals, during a period of twelve months, and involving the study of 7329 samples, failed to reveal the presence of a single typhoid bacillus. It would, however, be altogether presumptuous to infer from these observations that the typhoid bacillus is never present in the raw river waters, or to conclude that any relaxation in the processes of purifying the raw river waters, by storage and filtration, before delivery to consumer, is justifiable."

WE have received No. 1 of the weekly report of the seismological stations established by Messrs. Nobel at Baku and Balakhany, the instruments in each station being a pair of Zöllner light horizontal pendula with photographic registration. We may take this as an indication of the growing interest in the study of earthquakes and of the recognition of its economic applicability by a firm which has always been remarkable for enlightenment and progressiveness.

IN the *U.S. Monthly Weather Review* for August last Prof. C. Abbe, in a note entitled "The Duty of the Government to Protect the People from Swindlers," says, with reference to rain-making and other experiments:—"It is the duty of the editor to call attention to the fact that the folly of any human attempt to make rain or to alter the weather in any way has been so abundantly demonstrated in this country, in Europe, in Australia, in New Zealand, and elsewhere, that it is high time our law givers made it a penal offence to do this or to secure money under such false pretences as these promises are." No special mention is made of the dispersion of fog; would Prof. Abbe include this under altering the weather in any way?

THE current number of the Journal of the Scottish Meteorological Society (vol. xiv., No. 25) contains an important discussion of the climate of Orkney, by Mr. M. Spence. From 1827 to 1885 observations were made at Sandwick by the Rev. Dr. Clouston; since that time they have been continued first by Dr. Fortescue at Swanbister, and afterwards by Mr. Spence at Deerness. Dividing the mean temperatures into two periods of forty years, the first, 1827–66, gives 46°·1; the second, 1867–1906, gives 45°·6; difference, 0°·5. A comparatively small range is natural, from the insular position; the lowest mean for any month is 31°·3 (February, 1838), and the highest 61°·4 (July, 1852); the mean difference between day and night temperature is very small. The mean annual rainfall (1841–1907) was 36·7 inches; the driest month is May, the wettest October. The Orkneys surpass any other district in Great Britain in the number of gales, the yearly average being about ninety-seven. Winds from S. and S.E. are much more frequent than from S.W. and W. Mr. Spence remarks that the Orkney statistics "entirely dispose of the belief that is almost universal, at least in these islands, that there are equinoctial gales." Excepting that it avoids extremes, the climate as a whole does not vary greatly from that of the north of Scotland.

FROM a reprint that we have recently received of Prof. L. Palazzo's presidential address to the International Seismological Association at its meeting at the Hague in September, 1907, we observe that he attributes more par-

ticularly the great interest now generally taken in seismological studies to the hope that these may aid in solving the problems inherent to the constitution of the interior of the globe. In the course of his remarks he said that the great improvement in self-recording instruments has enabled us to determine the trajectories of the seismic waves, to study their reflection, refraction, dispersion, and absorption; but he remarks that we shall never be able to avoid the terrible scourge of the earthquake, nor even to foretell it. Modern discoveries, however, have led us to consider the interior of the globe to be formed of a solid nucleus, with a density and rigidity greater than that of steel. This nucleus is enveloped by a rocky crust, but between this crust and the metallic nucleus lies, at a great depth, the layer of plastic matter, of high temperature, which explains volcanic phenomena and their localisation.

We have received from the Royal Observatory of Belgium the results of recent balloon ascents made at Uccle, including those arranged for by the International Commission for Scientific Aëronautics, from July 27 to August 1. The observatory was very unfortunate during this period; the records of two ascents were wilfully destroyed, and only one ascent, that of July 30, reached a considerable altitude, 15·2 kilometres, where the temperature by M. Hergesell's metallic thermometer was $-59°·7$ C. The minimum reading of the up trace was $-69°·2$ C. at 13·2 kilometres. In the British Isles twenty-eight ascents were made during the above period, twelve of which were on account of the Meteorological Office. The preliminary results of the British series were communicated to the Royal Meteorological Society by Mr. C. J. P. Cave on December 16. The average height reached was 16·4 kilometres, the highest being 23 kilometres, at Pyrton Hill, Oxfordshire. The records of all the balloons recovered, except one, showed the existence of the isothermal layer.

Prof. Larmor pointed out several years ago in his "Æther and Matter" that the fundamental facts of optics and electrodynamics, those of aberration in particular, require us to assume that the æther does not partake to any sensible extent in the motion of matter through it. On this hypothesis there should, however, be certain modifications in the optical or electrical actions of bodies on each other according to the direction in which the æther is sweeping past them. Such effects have been sought for and not found, and the negative results led Profs. Lorentz and Fitzgerald to suggest as explanation that the bodies themselves undergo changes of shape when they move through the æther which accurately compensate these effects. More recently Prof. Einstein has shown that the "principle of relativity," according to which only relative motions of bodies with respect to each other can produce observable effects, leads to the same law of change of shape, and Prof. H. A. Bumstead, in an interesting article in the November number of the *American Journal of Science*, is disposed to accord it a position analogous to that of the second law of thermodynamics. He applies it in succession to the torsion pendulum, the gravitation pendulum, and to several problems of gravitation, and shows that it leads to a slight modification of the law of gravitation and to consequences which ought to be capable of detection astronomically.

As a supplement to *Rivista Marittima* (Rome) for November are published two papers, by Prof. Guido Cora, on geography and oceanography during the nineteenth century. In the second paper Prof. Cora gives a short, but comprehensive, review of the chief problems of oceanography from its foundation to the present time. The papers should be valuable as guides to work accomplished in geography and oceanography during last century.

Mr. C. Baker, of High Holborn, London, has forwarded a copy of the 1909 issue of section iv. of his catalogue. The catalogue is divided into four parts, dealing respectively with aids to vision, prismatic and other optical appliances, projection apparatus, and meteorological and allied instruments. We have also received the current issue of Mr. Baker's classified quarterly list of second-hand instruments which he has on sale or hire.

OUR ASTRONOMICAL COLUMN.

Search for an Ultra-Neptunian Planet.—Following the recent interesting discussion by Prof. Forbes at the Royal Astronomical Society, of the probable existence of a planet beyond the orbit of Neptune, there is an interesting note by Prof. E. C. Pickering in No. 4292 of the *Astronomische Nachrichten* (p. 323, December 18).

In this note Prof. Pickering mentions that as the result of an investigation, an abstract of which was read at the American Academy of Arts and Sciences on November 11, Prof. W. H. Pickering finds evidence of the existence of an ultra-Neptunian planet, which at the epoch 1909·0 will be located approximately in R.A. 7h. 47m., dec. $+21°$. Photographs of this region have already been taken with the 24-inch Bruce telescope at Arequipa, and the Rev. J. H. Metcalf is also employing his 12-inch doublet for the same research.

As this region is now easily accessible, Prof. Pickering asks that other astronomers, having the use of suitable instruments, should join in the search. Should the proposal be accepted by any number of workers, it is proposed that a systematic study of this portion of the ecliptic might be organised.

Further Observations of Morehouse's Comet, 1908c.—In No. 24 of the *Comptes rendus* (p. 1263, December 14) M. J. Guillaume gives some further interesting details concerning the remarkable changes which took place in the form of comet 1908c as observed at the Lyons Observatory.

On October 24 the nucleus was seen to be elongated and to have a granular appearance with a small stellar condensation, of about the thirteenth magnitude, towards the eastern extremity of the head. The light of a star, of the tenth or eleventh magnitude, appeared to be augmented as the head of the comet passed before it until it reached the eastern edge, when sudden diminutions of brightness occurred at intervals of several seconds.

Remarkable oscillations of the brightness of various parts of the coma were also observed, and on November 17, when the field of the telescope was artificially illuminated, the comet disappeared with a star of the ninth magnitude.

The same number of the *Comptes rendus* also contains the results of observations of the comet's position, made at the Toulouse Observatory between October 2 and 13.

The Figure of the Sun.—In No. 26 of the Contributions from the Observatory of Columbia University, New York, Prof. Charles Lane Poor brings together in a general discussion the results hitherto obtained from investigations dealing with the figure of the sun, and its possible variations.

Some of the earlier results were directly contradictory in their statements as to whether the equatorial or the polar diameter was the longer, whilst later results indicate that although there may be a fluctuating difference, its magnitude is insufficient to show definitely.

Prof. Poor, summing up the general results of the present investigation of meridian, heliometer, and photographic measures, concludes that the exact shape of the sun is not known, but the generally accepted idea that it is a sphere is at least open to question. All the measures show a departure from the spherical form, but the difference between the various radii probably does not exceed $0''·25$.

The available heliometer measures indicate a fluctuation of the sun's shape corresponding with the 11·3-year sun-spot period, but probably not exceeding 0"·10, whilst the observations of Ambronn and Schur possibly indicate another, shorter, period, of about twenty-eight days.

To determine this question, a long, homogeneous series of observations is necessary, and a photographic heliometer would probably furnish the best results. Experiments in this direction have already been made.

A REMARKABLE METEOR.—In No. 4287 of the *Astronomische Nachrichten* Prof. Kopff describes a remarkable meteor which left a persistent, drifting train for about half an hour. The meteor was first seen at 12h. 55m. (M.T. Königstuhl) at Heidelberg, and was brighter than Venus, its colour being a yellowish white. It appeared about 2° east of α Ursæ Majoris, and travelled along a path parallel to the line joining α and γ Ursæ. The luminous trail changed its shape and position, and was finally observed at 13h. 25m.

SUN-SPOTS IN 1907.—The frequency and heliographic distribution of sun-spots in 1907 are discussed by Dr. Rudolf Wolf in No. 99 of the *Astronomische Mitteilungen*. The monthly relative numbers show maxima in February and September, the daily relative number between February 9–14 exceeding 170; for the year the mean monthly number was 62·0. Some interesting tables and curves show the relations between the variations in sun-spot numbers and terrestrial magnetism.

THE PARALLAX OF 61 CYGNI.—The results of a new determination of the parallax of 61 Cygni, carried out by Prof. G. Abetti at Heidelberg 1906–8, are published in No. 9, vol. xxxvii., of the *Memorie della Società degli Spettroscopisti Italiani*. About 7000 observations were made, and their reduction, in three series, gives the following figures for the parallaxes of the components of the star:—61 Cygni pr. $\pi = +0''{\cdot}24$, mean error, $\pm 0''{\cdot}05$; 61 Cygni f. $\pi = +0''{\cdot}22$, mean error, $\pm 0''{\cdot}05$.

ADVANCE IN KNOWLEDGE OF CANCER.

IN conformity with a scheme of inquiry embarked upon in October, 1902, the third scientific report of the Imperial Cancer Research Fund, recently issued, treats, like its predecessors, of cancer as a problem of general and experimental biology. It contains no definite answer to the questions, What is the nature and what the cause of cancer? and beyond demonstrating that systematic experiment justifies the early surgical removal of a tumour as the only possible treatment at the present time, the report is silent as to remedial and preventive measures. These shortcomings will almost certainly arouse misgivings on the part of those who cannot appreciate how progress is made in any field of knowledge. They will also, no doubt, be seized upon by persons who, in their ignorance, assert that all scientific efforts should be concentrated on utilitarian ends, and they will be exploited by the charlatan, to whom for a space a free field is still left for his nostrums. The sustained efforts of the past six years to penetrate the mysteries of cancer have been accompanied by a corresponding activity on the part of faddists and quacks who advertise themselves by proclaiming the failure of scientific investigation to yield "practical fruits." The danger of their literary activity is but enhanced by the powers of diction and of exposition possessed by some of the writers. They could profitably devote their literary ability to expounding to the public the true facts and difficulties of the cancer problem instead of the ridiculous causes they maintain before a jury of the credulous and the suffering. In the absence of this enlightened attitude on their part it is my duty, since the second scientific report was followed by volumes of nonsense on the part of such persons, bluntly to inform the general reader of the folly of ignoring the necessity for the early surgical removal of cancer, and of running from one faddist or quack to another yet more ignorantly sanguine. If, in the future, the progress of scientific investigation provides a substitute for or an adjunct to surgical treatment, there will be no needless delay in placing it within the reach of the cancer patient.

Meantime, the importance of the investigation of cancer is only too grimly emphasised by its frequency as a cause of death. The number of deaths *recorded* from cancer increases from year to year throughout the world, civilised and uncivilised, human and animal. Taking England and Wales as an example, in 1889, on an average, the chance of a man above thirty-five years ultimately dying of cancer was one in twenty-one, and for a woman above the same age one in twelve. The increase in the number of deaths *recorded* from cancer makes the corresponding chances to-day one in eleven for men and one in seven for women. Scarcely a family of large size escapes attack. There is no circle of acquaintances, no chance assemblage of persons at a *table d'hôte* or in a tube lift, but contains prospective victims. But is cancer really increasing? The accurate use of statistics, and the careful scrutiny of the scientific value of the data upon which they are based, still withhold an affirmative answer. If it be further asked, Is not cancer much more frequent in races living under European civilisation than in the rest of mankind? recent investigation has disposed of the fiction that many races of mankind are exempt. Where the disease was said to be rare, *e.g.* in Japan, there are excellent statistics of which Europeans were previously ignorant proving the great frequency of cancer among the Japanese, and, taking another example, investigations in Indian hospitals show that certain forms of cancer very common in London hospitals are probably not less common in hospitals throughout Hindustan. In the case of most other races there are insurmountable difficulties in the way of even thus roughly estimating its frequency among them. Therefore it is idle to affirm or to deny that cancer may be more common in some races than in others. The disease occurs throughout the human race, and its association with forms of chronic irritation having nothing in common beyond this association is a fact of more moment than any futile discussion of the relative liability of different races. The additions, during six years, to our knowledge of its occurrence in man, as well as in tame and wild animals, tell hard against those who, at the close of the nineteenth century, argued that the increase in the number of deaths attributed to cancer was real, and merely a penalty for living under the influences of European civilisation.

Much additional evidence has been obtained of the extent to which cancer pervades the vertebrate scale. The similarity of the disease throughout vertebrates is illustrated most diagrammatically by a series of preparations of skin-cancers from mammals to marine fish living in a state of nature. Wherever data are available, for animals as for man, the liability to cancer is shown to be greatest in the last third of the span of life, whether it be short or long; the "age-incidence" of cancer in man has acquired enhanced significance by the establishment of this generalisation.

The widening of our knowledge of the occurrence of cancer is only one example of how revived interest in mere observation has put an end to the era of unverified, and often unverifiable, speculation which characterised the last twenty years of the nineteenth century, when exact methods of studying the clinical course, the anatomy, and the microscopical structure of tumours had reached their natural limitations. The study of cancer solely from the standpoint of its being an infective disease had yielded equivocal and self-contradictory results. Statistical methods had become barren from want of data to work on. No point vulnerable to an attack in the rear by the experimental method could be discerned.[1] In short, there was a standstill in the advance of knowledge. As is usual in all similar epochs in the progress of science, observation, hypothesis, and experiment had ceased to advance hand in hand. The arm-chair speculator had the field to himself. With only the knowledge derived from the bedside, the study of the structure of tumours in man, imper-

[1] As a matter of fact, such a point of attack had existed since the time when Hanau and Morau had successfully inoculated cancer from one animal to another, but those engaged in cancer research had either failed to realise the significance of this imperfect work or had been baffled by the difficulties which had to be overcome in attempting to imitate it.

fect data of its incidence in Europeans, and hearsay statements of its absence elsewhere to guide him, he little comprehended the futility of the explanations he so lightly advanced, and others of his kind equally lightly refuted. A general feeling of the hopelessness of penetrating to the truth was abroad, both among the public and the medical profession, who, the limits of surgical aid having been reached, were despondent in the extreme. The universality of this conviction led to the spontaneous and independent formation of "cancer research committees" in different countries at the end of the nineteenth century.

The whole outlook of the cancer question has been changed by the successful application of the comparative biological and experimental methods to its study, and by the restoration of the legitimate relations of observation, speculation, and experimental verification. In this revival the committees formed in different centres have played very unequal shares, according as their proceedings have conformed to the methods which advance natural knowledge. To demonstrate fully the adequate evidence upon which the claim—cautiously advanced in the first and second scientific reports and earlier papers—is based that a new and rational era of investigation has been inaugurated, and to urge continued confidence in the investigation of cancer, are the primary objects and the main justifications of the third scientific report of the Imperial Cancer Research. The time has not come when practical applications of the additions to knowledge are to be expected, nor has accident yet yielded any.

Although the rapid accumulation of new facts forbids the premature formulation of a generalisation attempting a unification of the mass of new and old knowledge, many results of far-reaching importance have been attained. The work of recent years has made it more certain than it ever was before that cancer contains no virus or other parasite foreign to the living organism. One is often asked if a relative suffering from cancer is dangerous to others, *e.g.* a grandmother to her grandchild the chief solace of her old age or if an historic family mansion should be burnt down because many progenitors inheriting it had died of cancer. During six years many tens of thousands of mice suffering from cancer have been under the most stringent observation. If cancer were communicable in the sense in which infective diseases are communicable, animals housed along with those naturally suffering from, or inoculated with, cancer would be the first to suffer. In an experience extending over six years, *i.e.* almost three times the average length of a mouse's life, exhaustive investigation has shown that this risk does not exist. This fact of itself satisfies those handling the animals. They incur still less risk in passing many hours daily dealing with cancerous animals in a room in which 10,000 of such mice and rats are usually housed at one time. If such a "cancer house" as never before existed has no dangers to human beings who spend their days in it, *a fortiori* other persons have no ground for apprehension. These results are of great practical value. They reinforce opinions often expressed in the past for other reasons. The presence, every day in the year, of some 50,000 persons suffering from cancer in England and Wales constitutes no menace to the health of those near and dear to them, nor to the health of the population generally, as would a smaller number of people suffering from small-pox. Notwithstanding the unwise assertions irresponsible enthusiasts will continue to make from time to time, what was a justifiable cause of public alarm has been removed by experiments on the transference of cancer from one animal to another, and on the housing of large numbers of cancerous with sound animals over a prolonged period. It has been demonstrated completely that artificial transference from animal to animal is due to the implantation of living cells. This is a factor which does not come in at all in reference to the frequency of spontaneous cancer in man or animals. In corresponding observations on mice suffering from spontaneous cancer no case of transference has occurred.

In this respect cancer presents a marked contrast to other diseases, *e.g.* tuberculosis, equally widely disseminated and common to man and the whole vertebrate phylum, for although no race of mankind is exempt, and cancer extends down the vertebrate scale to marine fish living in a state of nature, there are the most striking limitations to its communication from one individual to another. There is no connecting link, as it were, between the disease as it presents itself in nearly allied species nor yet even in individuals of the same species. There is nothing which, while foreign to the animal body, is nevertheless common to cancer wherever it occurs. There is nothing equivalent, *e.g.*, to the characteristics of tuberculous tissues which, no matter what the species of animal, are stamped with unmistakable common features by the presence of the tubercle bacillus. The properties of the tubercle bacillus obscure all the natural properties of the tissue containing it, and they confer upon such tissue new properties essentially the same in all species of animals. Tubercular tissue has common properties in all animals; the distinctions of species, and of individual tissues of one and the same species, are submerged in their acquirement of a new property, conferring on them the power of conveying the disease to previously healthy tissues, not only from one animal to another of the same species, but also to others of different species. The tuberculous *tissues* themselves, however, die when transferred to a new animal; they do not grow, they merely hand on the cause of the disease, viz. the bacteria, which continue to grow in new soil. How, then, is the pervasion of the animal kingdom by cancer explicable? It is intelligible because experiment has proved that cancerous tissues retain, not only the characters of the species of animal, but also those features distinguishing the several normal tissues of an individual and because the general conclusion from comparative and experimental investigation is that cancer arises *de novo* in each individual attacked, by a transformation of healthy tissue, one case of cancer having no relation to any other. This general conclusion is based upon observations and experiments of very varied but confirmatory nature.

When a piece of cancer-tissue of a mouse is implanted into another mouse, certain of the cells continue to grow in the new animal and others die. The cells which continue to grow are the cancer cells proper. The other cells which die, formed the scaffolding of supporting connective tissues and blood-vessels. The process of transference can be repeated *ad infinitum*, the powers of growth of the cancer cell being inexhaustible; they set at defiance the laws determining the specific sizes of the bodies and the organs of vertebrates, and determining the specific duration of the lives of different vertebrates. The cancer cells retain their characters unaltered in the course of artificial propagation, and the connective tissue scaffolding, supplied afresh by each successive host, remains identical with that which the cancer cells had in the animal where they originated. This scaffolding is called forth by the cancer cells themselves, and is of the nature of a specific reaction on the part of the ordinary connective tissues and blood-vessels of the host. The scaffolding is characteristically different for different tumours, and as will be stated below, the cancer cell is unable to continue to live and grow without it. The propagation of cancer is only possible in animals of the same species, *e.g.* from mouse to mouse or rat to rat, but not from mouse to rat or *vice versâ*.

Since the limits to transplantation are the same as those which limit the transplantation of normal tissues, *e.g.* the grafting of skin, the facts are of themselves evidence that cancer tissue contains nothing extraneous to the animal in which it appears. The distinctive differences in the new scaffolding which different tumours even of the same organ, *e.g.* the mamma, re-acquire after every transplantation are inexplicable on the assumption that the tumour cells contain a common virus endowing them with their peculiar properties. Thorough investigation of questions of metabolism has shown the relations of a tumour to its host to be merely those of nutrition, similar to those of the fœtus *in utero* to its mother. More than seventy transplantable tumours of very varied nature have been studied in the laboratory, and the above facts hold for them all.

The features of growth and of histology exhibited by different spontaneous tumours remain distinctive in the course of continued propagation, and they give weighty indications of the nature of the changes responsible for the acquisition of cancerous properties, since there is neither

progress to a uniform histological structure nor a gradual advance to the exhibition of uniform biological behaviour, nor acquisition of a uniform rate of growth. The transformation of normal into cancer cells really covers a scale of changes which do not pass into one another. Permanent features are stamped upon cancer cells at the outset. There is no transition from one degree of the cancerous change to another.

In the transplantation of a tumour into a new host success or failure is determined primarily by two factors. These are the qualities of the tumour cells and the nature of the "soil" the new animal offers. During continued propagation the cells of the tumours of a single organ, *e.g.* the mamma, exhibit other differences corresponding to those mentioned above with reference to the "supporting" scaffolding, and together with them pointing still more strongly to primary qualitative differences in the cells of different tumours. Although cancer occurs spontaneously mostly in old animals, young animals are more suitable for growth. The introduction of a minute particle of cancerous tissue into a normal animal leads to all the consequences which accompany the growth of a spontaneous tumour. Thus the adequacy of the assumption with regard to man, that the origin of cancer is primarily circumscribed, is demonstrated. A consideration of all the results proves that the genesis of a tumour and the growth of a tumour are two different things.

The "soil" which different races of mice offer, as it were, for the growth of cancer varies naturally in suitability; but tumours can gradually or rapidly adapt themselves to a soil which was unsuitable, *e.g.* when a Danish tumour was first transplanted in England it grew in only 5 per cent. of the mice inoculated, but later the success rose to 90 per cent. There are natural constitutional conditions which are favourable, and others which are unfavourable, to the growth of a tumour. The unfavourable conditions act as sieves, permitting certain kinds of cells to pass, and once they have passed they can multiply beyond our powers of measurement.

The "soil" can, however, also be modified experimentally. It can be made absolutely unsuitable for growth or rendered more suitable than normal. Mice and rats can be rendered unsuitable for growth only by vaccinating them with malignant new growths of their own species and by vaccinating with *normal* tissues of their own species. In the latter case the degree of "resistance" normal tissues produce directly corresponds to the closeness of the relationship between the normal tissue vaccinated and the tumour subsequently inoculated, *e.g.* skin protects best against skin cancer. These facts refer us back again to the limitations to the transplantation of tumours, and together with them demonstrate the retention by malignant new growths, not only of the tissue characters of a species, but also of the biochemical as well as of the histological characters distinctive of the several species. A sarcoma of a rat or cat, vaccinated into a mouse, lacks the power of protecting it against subsequent inoculation of a mouse sarcoma; this fact shows, as clearly as the method permits, the absence of any extraneous agent common to the growths of these different species. The growths of different species of animal resemble one another just as much, and differ just as much, as their respective organs and tissues do. As differences exist in certain properties of tumours already alluded to above, so corresponding other differences are revealed by the extent to which tumours, when vaccinated, induce protection against one another. A tumour does not vaccinate so well against other tumours as it does against itself or against those of its own kind. A lesser degree of protection which one kind of mouse-tumour induces against other kinds is due, probably, not to cancer-tissue as such, but to its properties *quâ* mouse-tissue.

Animals which are absolutely protected against inoculation do not yield a serum which, when introduced into new animals, has a power of protecting them against inoculation, still less is there any evidence of immune sera having a power to cure animals of tumours already growing. Highly immune mothers do not transfer immunity to their offspring as do animals immune to diphtheria or other poison of infective disease. Indeed, the mechanism of the protection which can be induced against cancer is of a kind quite unknown before. Most painstaking observations have been necessary to penetrate somewhat into its nature. Artificially protected animals do not supply the cancer cell with the peculiar scaffolding of supporting tissues it requires in order to grow into a tumour. It dies because it cannot grow into an organised tissue, and hence cannot nourish itself; being damaged, it falls a prey to the natural guardians—the phagocytes—of the body. The process is the same whether vaccination has been made with cancer or with normal tissue. The way in which this protection becomes general in the body fluids or tissues has not yet been fully ascertained; nevertheless, so far as it is known, it helps to elucidate the spontaneous healing of primary and secondary growths in man, and its further study gives promise of our being able ultimately to enhance the powers of resistance of the body to a degree which will prevent the dissemination of a primary growth.

Before so much can be attained there are many difficulties to be overcome, not the least of which is the discovery of the fact mentioned above, that the soil may be rendered more than normally suitable for the growth of cancer. Hypersensitiveness can be induced by many different agencies; indeed, as contrasted with the induction of protection, it is not specifically induced.[1] The growth of one tumour does at times make the "soil" of an animal more favourable for the growth of a second tumour, and therefore, presumably, for dissemination. It is much more difficult to protect an animal already bearing a tumour against the transplantation of a second tumour than it is to protect an animal which has not already got one.

Animals spontaneously attacked with cancer make efforts, which are sometimes successful, to cure themselves both of primary and of disseminated growths, *e.g.* in the vessels of the lungs. There is no longer room for scepticism regarding the statements which have been made from time to time of similar occurrences in man. The process of spontaneous healing is much more common in animals bearing transplanted tumours. In their case it can be studied in great detail, and it has been found to follow the same course as in man. A weighty factor contributing to its occurrence resides in the properties of the cancer cells themselves, for it has been discovered that they multiply with unequal rapidity at different times. They alternate regularly between positive and negative phases of growth. They are much more vulnerable to attack in the negative phase, *e.g.* through the heightened unsuitability or resistance which can be induced in the soil as described above. The further study of the relations obtaining here will ultimately assist us to prevent a primary tumour from disseminating and establishing offshoots in remote parts of the body.

A startling phenomenon has been stumbled upon during the artificial propagation of epithelial malignant new growths (carcinomata). In the course of time some of these tumours have been replaced by connective tissue new growths (sarcomata). There is no question of the conversion of epithelial into connective tissue cells. All the facts point to the acquisition of cancerous properties by what were previously normal connective tissues, viz. cells of the supporting scaffolding or "stroma." It appears probable that in this way malignant new growths have been produced for the first time experimentally. The development of sarcoma in this way occurs in circumstances throwing much light upon why cancer in man is so frequently associated with chronic irritation, as referred to above, and resulting continuous or intermittent attempts at regeneration and repair in man. Together with other facts, notably the differences in incidence of cancer in different races of mankind as determined by the application of irritants to different parts of the body, it gives the *coup de grâce* to the generalisation of the idea that cancer is of congenital origin.

Many new facts recorded above are of fundamental importance in enabling us better to comprehend the nature of cancer. Two factors have been proved to be of prime importance in its development; one is the alteration within

[1] The variety of the agents which render an animal hypersensitive for the growth of cancer acquires added interest when regarded in association with the variety of causes of chronic irritation related to the development of cancer in mankind, as referred to above.

a circumscribed area of what were normal into canceroos cells, either under the influence of unknown causes in the body itself or through the mediate intervention of diverse external chronic irritants, which may be actinic, chemical, bacterial, mechanical, in short, are legion; the other factor is the constitutional condition of the living body, which may favour or hinder growth of the limited number of altered cells into a tumour. Extensive observations on in-breeding stocks of cancerous mice show that in-born predisposition plays only a very subsidiary, if any, part in determining both the one and the other; both are acquired. Cancer is a foe to all men, and the liability to it being in all probability acquired may ultimately be found to be avoidable.

A sudden revolution of all former views on the nature and treatment of cancer has not been effected. Much of the knowledge inherited can be utilised, much of it must be discarded. I have not dwelt on the initiative, the sacrifices, and the patient toil of my colleagues Bowen, Cramer, Gierke, Haaland, Murray, and Russell, nor on the enlightened and generous encouragement of the executive committee of the Imperial Cancer Research. It will be evident to all who read my colleagues' papers in the report how much they have contributed to raise the British national investigations of cancer to the premier position among similar institutions abroad. I have not made reference to work by other distinguished investigators, but full credit is given to them in the report itself. Slowly feeling the way from one certain step to another has often simply meant being met by new and unsuspected difficulties. Each hitherto unsuspected difficulty when overcome has, however, brought us more nearly face to face with the realities of cancer genesis, cancer growth, and the natural means by which the body protects itself against them; they all are better comprehended and nearer solution to-day than ever before.

E. F. B.

STUDIES IN ANTHROPOLOGY.

THE growing interest in the study of anthropology as a branch of university teaching is illustrated by the publication of the Proceedings of the Anatomical and Anthropological Society of Aberdeen, of which Prof. R. W. Reid is chairman, for the years 1906–8. The most important contribution in the volume is a report by Dr. G. A. Turner on the natives of Portuguese East Africa south of latitude 22°. The habits, customs, and mode of life of the three chief races in this territory, the Myambaams, Mtyopis, Shangaans, and Lourenço Marques Boys, are described chiefly with reference to the principal forms of disease which appear in their kraals. Incidentally, some remarkable customs of much interest to the anthropologist are discussed. Thus, if a man dies of a disease like consumption, which causes constant gasping for breath, the officiant at the burial has to open the thorax of the deceased in the middle line and remove both the lungs and heart. These are so placed in the grave that they will not slip back into the thorax when they are laid upon it. The rite is obviously a piece of sympathetic magic intended to save the person conducting the interment from contracting the disease.

Full details are given of the remarkable habit of the Mtyopi women, who produce, by means of cicatrisation, lumps varying in size from that of a walnut to a pea along the breast, abdomen, and legs. The males of the same tribe file their teeth in the form of pegs, of which the rather doubtful explanation is suggested that it is a mark of primitive cannibalism, because they would be better able to tear human flesh if their teeth were filed. The existence of the practice, however, among tribes who are not cannibals seems to indicate that it is more probably one of the savage's misguided attempts at personal ornamentation. Witchcraft is common among these races, and the witch is much dreaded and often shamefully treated. Some natives, we are told, were in the habit of bringing suspected women for examination by the Portuguese commandant, who was asked to report on their alleged possession of supernatural powers. Finally, to put an end to such proceedings, he shrewdly gave as his verdict that while he was unable to detect anything extraordinary in the women, he could not speak with such confidence of their male companions. This opinion abruptly brought the investigation to a close. The methods of circumcision are fully described, the most remarkable feature in the operation being the extreme cleanliness enforced upon the performer of the rite, a precaution which usually obviates the risk of septic poisoning.

Local anthropology is represented by a paper by Dr. W. R. Macdonell on the physical characteristics of the medical students at the University, a summary of a long series of measurements which have been taken with the utmost care. For the purpose of comparison the subjects were divided into two groups, those of pure Scotch descent on both sides and those where one or both parents were foreign to Scotland. The general result is that in physical characteristics the two groups are practically identical. They closely resemble Cambridge students and graduates in length and breadth of head, but they are slightly lower in stature. In all three characters they are uniform with the rural population of Aberdeenshire. The average growth between the nineteenth and twenty-third year of age is about 1¼ per cent. in all characters except auricular height, in which it is about 3 per cent. There is practically no difference between honours and pass men in length and breadth of head, and the Aberdeen head is not larger than that of other classes of the community.

HYGIENE—PERSONAL AND ENVIRONMENTAL.[1]

THREE well-printed and well-filled volumes containing all the addresses and papers read at last year's School Hygiene Congress in London, and a summary of many of the important discussions, have been published recently. On a more leisurely and comprehensive review than was possible at the congress itself, one cannot but be struck with the small amount of irrelevant matter. School hygiene, involving, directly or indirectly, the whole series of systems of modern education, lends itself to the fanatic, the crank, and every other type of abstractionist. It is, however, with agreeable surprise that one finds here a large number of papers full of concrete experience, presented in a well-ordered way. Like the four volumes of the first congress (Nuremberg), these three form a most convenient conspectus of school hygiene at the present day. There are signs that the movement has become more mature, for the studies are in many respects more detailed. It is difficult to select papers for special observation, but there are many that will repay reading and re-reading. The general address by Bishop Welldon on "The Effect of School Training on Mental Discipline" contains many well-loaded aphorisms, but it is disconcerting to read:—"But, at whatever cost, the habit of unquestioned obedience must be created in the young. When I was headmaster of Harrow School, I used to say to my young colleagues, 'Begin by making the boys feel that you are prepared, if need be, to grind them to powder; then you may safely grant them as much liberty as you will.'" This is one ideal, but it is not the ideal of Froebel, of Pestalozzi, of Herbert Spencer, of Earl Barnes, of Stanley Hall.

The discussion on duration of lessons, sequence of subjects, and seasons of the year as affecting school work, contains good papers by W. H. Burnham (Clark University, Mass.), by M. Chabot (Lyons), who enters into much exact detail, and by Dr. L. Burgerstein (Vienna), whose well-known handbook on school hygiene is a standard. Another "set discussion on the lighting and ventilation of class rooms" contains a careful paper by MM. Courtois and Dinet. The general conclusion is that class rooms in France have too little cubic space, and that the air should be slightly warmed and free from dust.

Griesbach's method of estimating fatigue by the æsthesiometer was discussed by Dr. Altschul and others. Obviously, the method needs to be applied with skill, but, on the

[1] Second International Congress on School Hygiene. London, 1907. Transactions, Vols. i., ii., iii. Edited and arranged by the Ordinary General Secretaries, Dr. James Kerr and E. White Wallis. Price 5s. each volume; complete in three volumes, 12s. 6d.; bound 15s. net. Vol. i., pp. xxiv+391; vol. ii., pp. xv+401–848; vol. iii., pp. vi+849–1008. (London: Royal Sanitary Institute.)

whole, the conclusion was favourable. Dr. M. C. Schuyten (Antwerp) gives some favourable evidence, so does Dr. H. Baur (Wurttemberg), who used Scheiner's experiment as a test of fatigue. The question of suicide at school elicited a very full and detailed paper from Dr. G. W. Chlopin (St. Petersburg). It is obvious that national temperament, as well as school pressure, counts for much in the percentages. In Russia the suicide occurs three times as often in the middle schools for boys as among the general population of all ages. In the middle schools for girls the tendency to suicide is about three times weaker than at the gymnasium or real schools, and not more than in the general Russian population. No general solution is offered.

These papers are enough to indicate the large variety of material contained in these transactions. One general feature is obvious—personal hygiene distinctly predominates over environmental hygiene, although the latter is far from neglected. We have no space to note the papers on residential schools, school epidemics, administration questions, medical inspection, special schools, &c. The editors are to be congratulated on the practical nature of the volumes.

It is only right to direct attention to the elaborate address prepared by Prof. Griesbach on the relations between medicine and pædagogy; the tables are of great value.

PREHISTORIC POTTERY IN AMERICA.

THE Academy of Natural Sciences, Philadelphia, has issued as part of the thirteenth volume of its Proceedings another of its great monographs, finely illustrated with coloured and process plates, on a group of mounds in Arkansas and Mississippi, prepared by Mr.

Vessel of the "teapot" variety. Near Menard Mound. Height 6·25 inches.

C. B. Moore, who has made a speciality of this line of investigation. These mounds fall into three groups:—those of the Lower Arkansas, the Yazoo and Lower Sunflower Rivers, and those at Blu n. A number of interments, many of which are of the "bunched" or contracted type, has been examined, and a large collection of objects, such as pottery, bone pins, shell and copper ornaments, has been made. Some bones showing marks of specific disease have been unearthed, but there is some doubt whether these belong to the pre-Columbian period, and the sites may have been used for interments after Europeans reached the country.

The most important examples are those of pottery, which, though inferior to specimens found in other sites, is still highly artistic, well baked, and carefully wrought. It consists of pots, bowls, and bottles, of the last the long-necked or carafe type being comparatively abundant. An interesting variety is the "teapot" class, a vessel with a more or less globular body, a circular opening at the top surrounded by a low neck, with a spout and small knob at opposite sides of the body. This class, for the United States at least, seems to be peculiar to the Arkansas region. The pigments used are generally clays, white or tinted with iron oxides, of which careful analyses have been made by Dr. H. F. Keller. In decoration the scroll pattern is predominant; but in one very beautiful bottle the spaces in the yellow ware are defined on the body in white pigment, the interior being occupied by five-pointed stars and figures resembling an arrow-head, somewhat analogous to the copper pendants found at Moundville, the circular portions of which contain Swastikas or stars.

On the base of another vessel the Swastika reappears, and the same emblem is common on shells and stamped ware from the southern States. Prof. Holmes, in a contribution to this report, interprets this well-known symbol as a representation of the world, the division into four quarters being a convenient mode of marking the groups of guardian deities to whom it was necessary to make offerings or appeals. This explanation, however, hardly accounts for the symbol in other parts of the world. On the whole, these discoveries are of the highest value as opening up a comparatively novel chapter in the art development of prehistoric America, while the forms and schemes of ornamentation deserve the attention of designers in our day, who may find much interesting suggestion in the work of this early school of artistic pottery.

INHERITANCE IN SILKWORMS.[1]

IT is not surprising that animals which breed so fast and occupy so little room as silkworms should have afforded the material for the experimental investigation of heredity. The publication before us is the outcome of the third considerable series of breeding experiments with this moth. The first to appear was that of Coutagne ("Recherches expérimentales sur l'Hérédité chez les Vers à Soie"). This work was done without a knowledge of Mendel's observations, a fact which only increases the value of the work in the eyes of those who are not familiar with this author's other writings. The experiments, on the other hand, of Kametaro Toyama were carried out with the full knowledge of Mendelian principles, and were, indeed, set on foot with the object of testing them.

Mr. Kellogg's experiments were started a year later than Toyama's—in 1901. Mr. Toyama, who published his results before Mr. Kellogg, obtained results confirmatory of Mendelian hypotheses. But Mr. Kellogg does not find this to be the case with all his characters; in fact, he finds that the characters of the larvæ behave in Mendelian fashion in inheritance, whilst those of the cocoon exhibit considerable exceptions to this rule. The author suggests that the cause of this is that the cocoon characters have arisen by the selection of fluctuating variations, whilst those of the larvæ have arisen as discontinuous variations.

Mr. Kellogg's position with regard to the application of Mendelian principles to his results may be stated in his own words:—"Toyama finds the larval variation of colour-pattern and the cocoon differences of colour to follow Mendel's law. I do not. By the use of many repetition or check lots I find the larval characters to exhibit a great fidelity to Mendelian principles in their mode of inheritance, but with the cocoon colours I find exceptions so numerous, so varied, and so pronounced as to lead me to lay great stress on the potency or influence of individual or strain idiosyncrasies."

The chief criticism we are inclined to make is that far too little numerical evidence is given for the generalisations which are made. In an experiment in which nearly everything turns on the numerical proportion in which individuals with particular characters occur, we look for a far more detailed account of the results obtained. For example, Mr. Kellogg whets our appetite by telling of his experiments with a character of the egg, or rather of the female which lays it. Most races lay eggs which stick to the box in which they are laid, whilst some strains of the Bagdad race lay "non-adhesive" eggs. "The one race in my possession whose eggs are regularly (this regularity is not absolute) non-adhesive is the Bagdad

[1] "Inheritance in Silkworms" By Vernon L. Kellogg Leland Stanford Junior University Publications. University Series, No. i. Pp. 89. (California: Stanford University, 1908.)

race. . . ." Well, we want to know exactly how many have laid adhesive eggs. The author tells us that the egg-character is non-Mendelian, and that, though of course a character of the female, it is transmitted through the female. We want the details of the evidence on which this statement is based, in the form of a table preferably. In no case is the probable error of his results worked out.

THE OLDEST EUROPEAN SEDIMENTS.

MR. J. J. SEDERHOLM, director of the Geological Survey of Finland, has issued in English his "Explanatory Notes to accompany a Geological Sketch-map of Fenno-Scandia" (Helsingfors: Frenckellska Tryckeri-aktiebolaget, 1908). The beautifully coloured map of Norway, Sweden, and Finland (Prof. W. Ramsay's "Fenno-Scandia") that accompanies this memoir was originally issued in Bulletin No. 23 of the Commission géologique de Finlande. Photographs are given of critical rock-specimens, such as the conglomerates that mark unconformities between the Archæan systems in Finland, and the early pre-Cambrian (Bottnian) banded sediment of the shores of Näsijärvi. This rock indicates seasonal stratification, strangely like that of the adjacent Glacial clays of Pleistocene age.

Those who have seen the actual specimens, or, better still, the beds in the field, cannot deny the existence of an immense series of pre-Cambrian sediments in Fenno-Scandia. The gneisses, such as those of the Hangö islets, are by no means the oldest or fundamental rocks, but result from the intrusion of granite into various series and at various times. Some of the granites in the north of Finland appear to be post-Silurian, as in Scandinavia. Sederholm's admirable summary is, of course, written from a Finnish point of view, and some of the results may meet with criticism when applied to Scandinavia; but they deserve the keen attention of geologists in our own islands, where post-Silurian movements have masked much of the older sequence, but where patches of ungranitised pre-Cambrian sediments may remain amid metamorphic areas.

A visit to Finland healthily counteracts the tendency, still apparent in some quarters, towards bringing all our clearly stratified rocks somehow into the Palæozoic era. Dr. A. Mickwitz has recently proposed (*Bulletin de l'Académie impériale des Sciences de St. Petersbourg*, 1907, p. 699) to correlate the results of deep borings on the south side of the Gulf of Finland, in the hope of ascertaining the relations of the lower Cambrian strata of Russia to the pre-Cambrian beds that appear across the sea in Finland. Perhaps the areas still unexplored by the Finnish Survey may include some Palæozoic strata. For the present, the "Jatulian" dolomites, sandstones, and true bedded anthracites are sufficiently fascinating. What forms of vegetable life in pre-Cambrian times furnished the bed of coal 7 feet thick in Olonetz?

G. A. J. C.

METEORIC SHOWER OF JANUARY.

THE Quadrantids, or Boötids as they are sometimes called, the former constellation being modern and not fully recognised, ought to reappear under favourable auspices on the nights of Saturday, January 2, and Sunday, January 3; but the shower is a very fugitive one, and its more abundant phase will probably be confined to a few hours on one of the nights mentioned.

These January meteors really form a very rich stream, and I believe that, next to the Perseids, Leonids, and Andromedids, they are entitled to take precedence as regards numbers; but the annual returns are seldom well observed in this country owing to cloudy weather, moonlight, and other causes. Moreover, the radiant is only at a satisfactory height for the plentiful display of its meteors just before sunrise. At 9 p.m. in the latitude of Greenwich the point of radiation is only fourteen degrees above the northern horizon. Observations are best made, therefore, in the early evening between 5 p.m. and 6 p.m., or during the few hours before sunrise.

The meteors are generally fairly bright, with long, rather swift flights and flaky trains. They are decidedly conspicuous objects, and easily identified from members of the secondary showers of the epoch, which are not abundant or individually rich. This year the gibbous moon will slightly interfere with observations before midnight, but the morning hours, if atmospheric conditions allow, ought to provide a very suitable time for witnessing the spectacle.

W. F. DENNING.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE annual meeting of the Mathematical Association will be held on January 12, 1909, at King's College, London. Addresses will be delivered by Dr. H. T. Bovey, F.R.S., rector of the Imperial College of Science and Technology, on the mathematical preparation for students who propose to take up technical work; by Mr. Alfred Lodge, on the introduction of the idea of cross-ratio and homography, and its connection with involution; and by Prof. G. H. Bryan, F.R.S., on a proposal for the unknown digit.

THE annual meeting of the Geographical Association will be held on January 6, 1909, at the London School of Economics. In the morning, at 11.30, short papers on practical problems will be read. Mr. J. Fairgrieve will deal with the weather report and the teaching of geography, Dr. A. J. Herbertson will give hints on hanging and storing maps, and Mr. J. A. McMichael will give a demonstration of the method of making models by serial sections. In the afternoon, after a business meeting, the president, Mr. Douglas W. Freshfield, will deliver his address, Dr. H. R. Mill will lecture on the rainfall of the British Isles, and a lantern exhibition will be given of the set of views of the Dora Baltea, which has been prepared for the association by Mr. G. W. Palmer. The Geographical Association is, we are glad to find, continuing its excellent work in the direction of encouraging more scientific methods of teaching geography in schools. Monthly meetings for teachers and others are to be held on the last Friday evenings of January, February, and March next for the discussion of problems likely to assist teachers in their work, and in other ways the association is endeavouring to assist improved methods of geographical instruction. The honorary correspondence secretary, Mr. J. F. Unstead, 39 Greenholm Road, Eltham, is willing to give full particulars of the work of the association.

THE annual meeting of the recently formed American Federation of Teachers of the Mathematical and Natural Sciences was held at the Johns Hopkins University, Baltimore, on December 28 and 29. On the second day a joint meeting was held with the American Association for the Advancement of Science, at which numerous problems of science teaching were discussed. From Bulletin No. 1 of the federation, which has been received, we learn that seven associations have formally joined the federation. Fourteen others have the matter under consideration, and are expected to take action on it at their next meetings. Among pieces of work of obvious interest and importance which the federation proposes to undertake may be mentioned investigations and reports on such matters as the bibliography of science teaching and the history of science; the best means of publication for new material of interest to teachers of science; the best means of securing the most favourable conditions for science teaching, including a share in the shaping of college entrance requirements. It is important to notice that the articles of the federation provide, not for the formation of a new national society of teachers of mathematics and science, but for a collective representation of existing local societies in matters of broad general interest. Each local society, of which there are many in the United States, preserves its independent identity and methods of work. Already the federation has begun work by undertaking the compilation of a bibliography of the literature on the teaching of science and mathematics. The work is being done by cooperative effort, part having been assigned to each of the federated associations. A committee on bibliography has been appointed, with Prof. Richard E. Dodge, of Teachers' College, New York, as chairman. The list to be prepared is to "include books, articles in periodicals, scientific journals or association reports, including foreign contribu-

tions, if any." The object is to prepare a bibliography of contributions to science teaching in the last decade "that will be a working basis for any teacher of science, and especially for any in an institution with limited library facilities." Since reviews of recent publications on science teaching are valuable in making up programmes of study, this bibliography should be an aid in this way, and should encourage the study of the literature of the subject. For convenience and effectiveness in covering the whole field of science teaching, specialists have been appointed to undertake the work in six subdivisions. The federation has already a membership of more than 1600, and is the most representative body of teachers of science in America.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 25.—"Note on the Instability of Tubes subjected to End Pressure, and on the Folds in a Flexible Material." By A. **Mallock, F.R.S.**

When a straight rod is subjected to end compression it is stable for small lateral displacements unless the compressing force exceeds a definite limit, depending on the elastic constants of the material of the rod and its length and cross-section dimensions.

If this limit is exceeded the rod is unstable, and the least departure from straightness grows under the action of the force, the axis of the rod then taking the form of

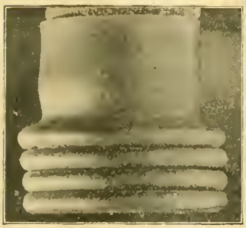


FIG. 1.

FIG. 2.

FIG. 3.

one of the well-known elastic curves, and this is the only form which a solid rod can take in the circumstances.

With tubes and plates, however, the case is different, for with the tube the ratio of the thickness of the walls to the diameter of the tube has to be considered as well as the ratio of the diameter to the length. Thus a tube the length of which is insufficient to produce instability involving a bending of the axis may become unstable by the crumpling up of the walls, the axis itself remaining straight.

In the case of solid rods the governing condition is the constancy (to the first order) of the length of the axis; with tubes and plates it is the constancy to the same order of the area of the mid-wall surface. Considering the case of tubes in rather more detail, take the axis of the tube as z and let its unstrained radius be r_0.

Under end compression the surface may become unstable by deformation into any of the cylindrical harmonics of the type

$$r = r_0 + a \cos n\theta \cos \frac{2\pi}{\lambda} z,$$

where θ is the angle which r makes with a fixed diameter of the tube and λ the length of the fold parallel to the axis. The order of the harmonic which will naturally be assumed by the deformed tube depends on the ratio (h/r) of the thickness of the walls to the diameter, and will be such that the potential energy of the combined bending and shearing involved may be a maximum.

If the crushing is continued until the tube is greatly reduced in length the folds are seen to develop into the symmetrical shapes shown in the photographs (Figs. 1, 2, 3), for which $n=1$, 2, and 3 respectively. For $n=1$ the folds are circular in plan and independent of θ; when $n=2$ the plan of the folds is a square, and when $n=3$ the plan is hexagonal.

It may be noticed that the instability always shows itself first at one end, and that since the reaction against end pressure decreases as the deformation goes on, each fold is completed in succession, the next not becoming marked until the reaction is increased by the previous fold resting against the last but one.

November 5.—"Note on Tidal Bores." By Lord **Rayleigh,** O.M., Pres.R.S.

It was shown long ago by Airy that when waves advance over shallow water of depth originally uniform, the crests tend to gain upon the hollows (see also "Scientific Papers," vol. i., p. 253, 1899), so that the anterior slopes become steeper and steeper. Ultimately, if the conditions are favourable, there may be formed what is called a *bore*. Ordinary breakers upon a shelving beach are of this character, but the name is usually reserved for tidal bores advancing up rivers or estuaries. Interesting descriptions of some of these are given in Sir G. Darwin's "Tides" (Murray, 1898).

Although the real bore advances up the channel, we may for theoretical purposes "reduce it to rest" by superposing an equal and opposite motion upon the whole water system. We have then merely to investigate the transition from a relatively rapid and shallow stream of depth l and velocity u to a deeper and slower stream of depth l' and velocity u' (Fig. 1). The places where these velocities and depths are reckoned are supposed to be situated on the two sides of the bore, and at such distances from it that the motions are there sensibly uniform. The problem being taken as in two dimensions, two relations may at once be formulated connecting the depths and velocities. By conservation of matter ("continuity") we have

$$lu = l'u' ; \qquad (1)$$

FIG. 1.

and since the mean pressures at the two sections are $\frac{1}{2}gl$, $\frac{1}{2}gl'$, the equation of momentum is

$$lu(u-u') = \tfrac{1}{2}g(l'^2 - l^2) ; \qquad (2)$$

whence

$$u^2 = \tfrac{1}{2}g(l+l').l'/l, \qquad u'^2 = \tfrac{1}{2}g(l+l').l/l'. \qquad (3)$$

The loss of energy per unit time at the bore is thus

$$lu(\tfrac{1}{2}u^2 + \tfrac{1}{2}gl) - lu(\tfrac{1}{2}u'^2 + \tfrac{1}{2}gl') = lu.g(l'-l)\frac{l^2+l'^2}{4ll'}. \qquad (4)$$

That there should be a loss of energy constitutes no

difficulty, at least in the presence of viscosity; but the impossibility of a gain of energy shows that the motions here contemplated cannot be reversed.

In order to recur to the natural condition of things where the shallow water is at rest, we have to superpose the velocity u taken negatively upon the above motion. The velocity of the bore is then u, and that of the stream above the bore $u-u'$. If l is relatively small, u is much greater than u'.

The reasoning just used is very similar to that applied by Stokes (*Phil. Mag.*, vol. xxxiii., p. 349, 1848) and by Riemann (*Göttingen Abh.*, vol. viii., 1860) to sound waves of expansion moving in one dimension. The matter is discussed in "Theory of Sound," § 253, where it is shown that the discontinuous solution, obtained from the principles of conservation of mass and momentum, violates the condition of energy. When this was pointed out to Stokes by Kelvin, and later by myself (Stokes, "Math. and Phys. Papers," vol. ii., p. 55), he abandoned his solution, which is, however, maintained by a competent German authority (private correspondence). It is clear, at least, that when the motion is such as to involve a gain of energy, the solution cannot be admitted. The opposite case stands upon a different footing, and we may, perhaps, imagine the redundant mechanical energy to be got rid of somehow at the surface of discontinuity. Even then we should have to face the complication entailed by the development of heat. In the present case of liquid, the heat is of little consequence, and since the motion is not entirely in one dimension, we escape the necessity of dealing with a single plane of discontinuity.

November 12.—"Further Observations on Welwitschia." By Dr. H. H. W. **Pearson.** Communicated by Prof. A. C. Seward, F.R.S.

The material which forms the subject of this investigation was collected at Welwitsch and Haikamchab, in Damaraland, in January and February, 1907. Macrospores and embryo-sacs are frequently present in the pith region of the female cone-axis. This confirms the view, already adopted by most authors, that the ovule of Welwitschia is cauline. Sporogenous cells have not been found in a similar position in the male cone.

The female cone and the male flower are probably derived by reduction and specialisation from an amphisporangiate strobilus of a type similar to that of Bennettites.

At the end of the free nuclear division the embryo-sac contains about 1024 nuclei which are equivalent in all visible characters. Cleavage of the cytoplasm occurs, resulting in the septation of the whole sac into compartments. In respect of the morphological character of the endosperm, Gnetum and Welwitschia are widely separated from Ephedra, in which the endosperm is a prothallus of the normal gymnosperm type. It is suggested that the endosperm of the primitive angiosperms was homologous with that of Welwitschia.

It appears that (1) the Gnetum-Welwitschia alliance has its origin in the same stock as the angiosperms, but separated from the angiosperm line before the carpel became the pollen-receiver; (2) Welwitschia is the most specialised living representative of the race to which it belongs.

Zoological Society, December 15.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—Some notes on the muscular and visceral anatomy of the batrachian genus Hemisus, with notes on the lymph hearts of this and other genera: F. E. **Beddard.**—New species of Lacerta from Persia: G. A. **Boulenger.**—Some wart-hog skulls in the British Museum: Dr. Einar **Lönnberg.**—Two Chinese Serow skulls: R. **Lydekker.**—Warning coloration in the musteline Carnivora: R. I. **Pocock.**—A new river-crab of the genus Gecarcioucus, from New Guinea: Dr. W. T. **Calman.**—Mammals collected in the provinces of Shan-si and Shen-si, northern China, by Mr. M. P. Anderson, for the Duke of Bedford's zoological exploration of eastern Asia: Oldfield **Thomas.** Thirty-three species were included, represented by 335 specimens, presented, as before, to the National Museum by the Duke of Bedford.

Linnean Society, December 17.—Dr. D. H. Scott, F.R.S., president, in the chair.—The Anomura of the Sudanese Red Sea: W. **Riddell.** Forms of flowers in *Valeriana dioica*: R. P. **Gregory.** In 1877 Hermann Müller described four forms of *Valeriana dioica*, distinguished from one another by the size of the flower and by the relative development of the male and female reproductive organs. The phenomenon appears to be very similar to that which was described by Darwin in *Rhamnus catharticus*. It has been found that the individuals of *Valeriana dioica* may be conveniently arranged in four groups, which are distinguished as, respectively, "female," "hermaphrodite," "long-styled male," and "short-styled male"; but while the central types of each group are readily distinguishable, it must be distinctly recognised that they are connected by a series of intermediate forms, and that there is no discontinuity between successive groups. The precise structure of the flowers of each plant varies considerably, as regards the relative development of the reproductive organs, with the age of the flower examined; but in addition to this there is, in some cases, a very wide range of variation in this respect, quite independent of the age of the flower.—Études sur les Cirrhipèdes du Musée de Cambridge: Prof. **Gruvel.** The Rhynchota obtained on the *Sealark* Expedition: W. L. **Distant.** The author stated that the collection made by Mr. Gardiner in the Seychelles comprises forty species, viz. twenty-eight species of Heteroptera and twelve of Homoptera. Walker was the first to write on the Heteroptera of these islands, and in 1872 he described three species collected by Dr. Perceval Wright, one of which was found by Mr. Gardiner. In 1893 Bergroth and Reuter worked out the collections made by M. Ch. Alluaud and Père Philibert so far as the Heteroptera was concerned, and were able to enumerate thirty-seven species.

Geological Society, December 16.—Prof. W. J. Sollas, F.R.S., president, in the chair.—The igneous and associated sedimentary rocks of the Tourmakeady district (County Mayo): C. I. **Gardiner** and Prof. Sidney H. **Reynolds,** with a palaeontological appendix by F. R. C. **Reed.** The succession of the Ordovician rocks of the district appears to be as follows:—? Bala beds; Llandeilo beds: (c) Shangort beds; (b) Tourmakeady beds; (a) red felsite or rhyolite; Arenig beds Mount Partry beds: (d) variable tuffs, grits, and cherts; (c) coarse quartzose and felspathic grits; (b) grits, graptolitic black slates, and radiolarian cherts; (a) coarse conglomerates. A series of graptolites from the Mount Partry beds prove to be of Upper Arenig age—about the zone of *Didymograptus hirundo*. The puzzling beds of the district are those of Llandeilo age. Although the limestones (Tourmakeady beds) occur in the main as disrupted blocks in the Shangort beds, the fossils indicate that there is little difference in the age of these deposits; probably, after the deposition of the limestone, but during the prevalence of the same faunal types as those of that deposit, the limestone was broken up by volcanic explosions, and its fragments were deposited as the peculiar limestone-breccias. The intrusive rocks are in the main felsites with quartz-crystals, and often contain augite. Interesting intrusions of olivine-dolerite, hornblende-lamprophyre, and fine-grained oligoclase-bearing rocks are scattered throughout the district. The appendix embodies a description of new species of brachiopods and trilobites.

PARIS.

Academy of Sciences, December 14.—M. Bouchard in the chair.—The approximate calculation of inequalities of a high order: Maurice **Hamy.** A calculation to the second degree of approximation of the disturbance of one planet by another.—Contribution to the study of *Haemogregarina lacertae* of Danilewsky and Chalachnikow: A. **Laveran** and A. **Pettit.** A detailed account of the appearances of this parasite in various stages of development, with nine illustrations.—Observations concerning the direct dehydration of certain alcohols: Louis **Henry.** In an earlier paper it has been shown that dimethyl-isopropyl-carbinol, heated with acetic anhydride and a few drops of sulphuric acid, gives, not the acetate, but a mixture of the hydrocarbons

tetramethyl-ethylene and isopropyl-methyl-ethylene. In this reaction the acetic anhydride was regarded as the true dehydrating agent, but in the present paper this view is shown to be incorrect. In the absence of the sulphuric acid the acetate is alone formed, and it is the presence of the very small amount of sulphuric acid which determines the formation of the ethylenic hydrocarbons.—Physical observations of the comet 1908c, made at the Observatory of Lyons: J. **Guillaume.** A detailed account of the changes of form undergone by the comet as observed between October 24 and November 28.—Observations of the Morehouse comet, 1908c, made with the Brünner-Henry equatorial of the Observatory of Toulouse: MM. **Saint-Blancat** and **Rossard.** Two tables giving the results of observations of the positions of the comet and of the comparison stars between October 2 and 14.—Geodesic lines: Jules **Drach.**—The number of double integrals of the second species of certain algebraic surfaces: L. **Remy.**—Description of the Voisin aëroplane used by MM. Farman and Delagrange: G. **Voisin.**—The compensation of compasses of great magnetic moment: Louis **Dunoyer.** The magnetic dichroism of calcite and of dolomite in mixed liquids: Georges **Meslin.**—The influence of pressure on the phenomena of ionisation; curves of current and curves with constant field: E. **Rothé.**—Rotatory power at low temperatures and the connection between the absorption of light and rotatory polarisation in crystals of cinnabar: Jean **Becquerel.**—The theory of absorption in gases: L. **Bloch.** A modification of Lorentz's theory on the basis of Walker's hypotheses. The formulæ arrived at still await experimental verification.—The magnetism of the rare earths: B. **Urbain** and G. **Jantsch.** For groups of the rare earths, the salts of which possess nearly identical solubilities, and the atomic weights of which are nearly the same, the coefficients of magnetisation vary considerably, and hence may serve to determine the composition of mixtures which scarcely admit of analysis by other methods. Results are given of measurements of oxides of the type X_2O_3, in which X may be neodymium, samarium, europium, gadolinium, terbium, or dysprosium.—The variations of the composition of the colloids which are formed in a solution of ferric chloride according to the conditions of hydrolysis: L. **Michel.**—Remarks on the magnetic properties of the simple bodies: P. **Pascal.** The following law is enunciated:—the atomic susceptibility is an exponential function of the atomic weight for diamagnetic bodies of the same valency and of analogous chemical properties. Some of the experimental data in support of this are given.—The preparation of thorium chloride: Camille **Matignon.** The oxide is heated in a mixture of chlorine and the vapour of chloride of sulphur, the chloride being formed at a temperature sufficiently low to permit the use of glass tubes in the place of porcelain tubes required by other methods. Thorium chloride, if quite pure, is not so hygroscopic as has been stated by previous workers.—Studies on aluminium. The analysis of aluminium powder: E. **Kohn-Abrest.** Two methods of analysis are suggested, and the results given of their application to a sample of aluminium powder.—The dissociation of sodium bicarbonate: M. **Soury.**—The atomic weight of silver: Louis **Dubreuil.** A reply to some recent objections of A. Leduc.—The true atomic weight of silver: G. D. **Hinrichs.** The value 108 is maintained to be the true experimental atomic weight of silver.—The action of sulphur chloride (S_2Cl_2) on metals and metalloids: Paul **Nicolardot.** In all the actions described S_2Cl_2 acts like HCl, and not as a chlorinating agent.—The action of heat on iodic anhydride: Marcel **Guichard.** Iodine pentoxide is unchanged by heating until a temperature of 300° is reached. Above this temperature iodine and oxygen are given off. The non-decomposed portion becomes chestnut coloured. Comparative analyses of the white and brown anhydride gave similar results, all agreeing well with the composition of I_2O_5. The brown colour appears to be due to minute traces of iodine retained by the undecomposed anhydride, and no proof of the formation of a lower oxide could be obtained.—Research on the occluded gases contained in a complex brass containing manganese and filled with cavities: G. **Guillemin** and B. **Delachanal.**—The waxes of the Coniferæ: a new group of natural principles: J. **Bougault** and L. **Bourdier.**—Syntheses of derivatives of camphenylone: J. **Bouveault** and G. **Blanc.**—The action of sulphuric acid on aldehyde and paraldehyde: the preparation of crotonic aldehyde: Marcel **Delépine.** Acetaldehyde, carried as vapour in a current of air into pure sulphuric acid maintained at 10° C. to 15° C., is absorbed, and distillation of the diluted acid gives a 30 per cent. yield of crotonaldehyde, together with a new polymeride, $C_8H_{12}O_2$. The substitution of paraldehyde for aldehyde improves the yield.—The action of acids on diiodo-α-methylsparteine: Amand **Valeur.**—The action of ferments at varying temperatures: C. **Gerber.**—Attempts at the molecular analysis of protoplasmides: A. **Etard** and A. **Vila.** Anhydrous methyl alcohol is suggested as a suitable means of separation.—The influence of some mineral salts, especially stannous chloride, upon fermentation: G. **Gimel.** Two types of yeast (the elliptic wine yeast of Jacquemin and a distillery yeast of the Frohberg type) have been submitted to the action of salts of various metals. The results with tin and bismuth salts are the most striking. The addition of 0·01 per cent. of stannous chloride increases the yield of alcohol by 4 per cent., a property possessing obvious industrial applications.—The influence of light on the development of fruits and seeds: W. **Lubimenko.**—Contribution to the cytological study of the Endomyces: *Saccharomycopsis capsularis* and *Endomyces fibuliger*: A. **Guilliermond.**—The production of a new variety of spinach, *Spinacia oleracea*, var. *polygama*: M. **Blaringhem.**—The structure of the ciliary retina: J. **Mawas.**—An Acrasped without medusa: *Taeniolhydra Roscoffensis*: Edgard **Hérouard.**—The rhythmic appearance and stages in the experimental inversion of the chlorotropism of the Paguræ: Romuald **Minkiewicz.**—Studies on the cancer of mice: the histophysiology of certain cells of the conjunctival stroma of tumour B: L. **Cuénot** and L. **Mercier.**—The treatment of deep-seated tumours by a method allowing the action of radiant matter to proceed at close quarters with the tissues without altering the teguments: E. de Bourgade **la Dardye.** Zinc sulphide is injected, and this rendered phosphorescent by the X-rays. Cases are cited in which the method has been used with advantage. The treatment of arterial hypertension by the high-frequency current: G. **Lemoine.** Good results have been obtained in five cases, full details of each being given.—The radiographic study of the articulation of the elbow and knee in a girl three and a half years of age: Maxime **Ménard.**—The fossil man found at Chapelle-aux-Saints (Corrèze): Marcellin **Boule.**—The white rhinoceros, re-found in the Soudan, is the unicorn of ancient times: E. L. **Trouessart.**—The Haleciidæ, Campanulariidæ, and Sertulariidæ of the *Challenger* collection: Armand **Billard.**—The appearance of males and hermaphrodites in parthenogenetic reproduction: J. **Pantel** and R. **de Sinéty.**—Microseisms of long duration: José Comas **Solá.**—The Phoridæ and Leptidæ of Baltic amber: Fernand **Meunier.**—The influence of deflation on the constitution of the ocean floor: J. **Thoulet.**

December 21.—M. Émile Picard in the chair.—Remarks on Fredholm's equation: H. **Poincaré.**—The action of lines of electric energy on hailstorms: J. **Violle.** In a previous note the author described the ravages caused by a hailstorm, the path of which followed exactly a wire carrying current at a high potential. Such a wire gives off torrents of ions carrying large electric charges, the effects of which are exactly comparable with those produced by the hail cannon. Although one electric transmission line is insufficient to protect a district, several might have a protective effect.—The mode of action of electricity in electric parthenogenesis: Yves **Delage.** It has been found that the condenser used in the experiments previously described permitted a leakage of current, the resistance being of the order of 20 megohms. It is conceivable that the acid and alkali produced by this current from the salt in the solution might account for the observed phenomena, which would thus reduce to a case of chemical parthenogenesis.—The forms of endogenous multiplication of *Haemogregarina lacertae*: A. **Laveran** and A. **Pettit.** A detailed description with diagrams.—Observations of the

sun, made at the Observatory of Lyons during the third quarter of 1908: J. **Guillaume.** Observations were taken on sixty-seven days, and the results are summarised in three tables giving the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—The cyclid of Lie: A. **Demoulin.**—The singularities of analytical functions: Paul **Dienes.**—Multiform integrals of differential equations of the first order: Pierre **Boutroux.**—The condition that seven right lines should be situated on a surface of the fourth degree: E. **Traynard.**—The Thomson formula, $T=2\pi\sqrt{CL}$, relating to the discharge of a condenser: André **Léauté.** In the case of coils carrying several layers of wire, the capacity is no longer negligible, and the Thomson formula requires modification. The theory of this case is developed in the present paper, and it is shown that the current due to the discharge of a condenser through a coil with two layers may be considered as formed by the superposition of an infinite number of sinusoidal currents, the amplitude of which tends towards zero with the period. This theory explains the presence of striæ in induction sparks.—The radiation and temperature of the flame of the Bunsen burner: E. **Bauer.** The temperature of the Bunsen flame found by these measurements is $1760^{\circ} \pm 50$, and is near the 1870° found by M. Féry, on the assumption that the emission of the D line is a purely thermal phenomenon.—Supertension and viscosity: Ch. **Marie.**—The synthesis of ammonia by means of peat: H. **Woltereck.**—The inconveniences of potassium bichromate when used as a preservative for milk samples intended for analysis: A. **Monvoisin.** The addition of 0·1 per cent. of potassium bichromate to milk samples intended for analysis is at present compulsory in France. This addition prevents the detection of added formaldehyde or hydrogen peroxide, and also renders it impossible to state whether the milk has been heated or not. Contribution to the study of the humic matter in peat wool: L. **Roger** and E. **Vulquin.**—The reciprocal influence of respiratory phenomena and the behaviour in certain Actinia: Henri **Piéron.**—The development and affinities of *Sorosphaera Veronicae*: R. **Maire** and A. **Tison.**—Carpocyphosis: the normal anatomy and pathology of the lower radio-cubital articulation: R. **Robinson.**—The discovery of a human skeleton at Chapelle-aux-Saints (Corrèze): A. and J. **Bouyssonie** and L. **Bardon.** Details of the discovery and removal of this fossil skeleton, described by M. Boule in the *Comptes rendus* of last week. Both above and around the skeleton were many broken bones, as well as tools of flint and quartz. The animal remains included the reindeer, horse, and a large ruminant.—The anatomy of the appendicular organs of the female reproductive apparatus of *Periplaneta orientalis*: L. **Bordas.**—Experimental researches on the evolutive mutations of certain crustaceans: Edmond **Bordage.**—The upper limit of the proportion of the encephalus with respect to the weight of the body in birds: Louis **Lapicque.**—*Syllis vivipara* and the problem of its sexuality: Aug. **Michel.**—Filtration of the X-rays by aluminium: H. **Guilleminot.**—Geological structure in the Salzkammergut in the neighbourhood of Ischl and Aussee: Émile **Haug.**—The hydrography and climate of Algeria since the Oligocene epoch: J. **Savornin.**—The substratum of the *nappe du charriage* in the Peloponnesus: Ph. **Négris.**—The supposed submarine spring of the Port-Miou (Bouches-du-Rhône): E. A. **Martel.** This spring, the existence of which has been described in various works for the last 200 years, does not appear to exist.—The variations of climate: Henryk **Arctowski.**—The seismic disturbances of December 12 and 18, 1908: Alfred **Angot.**—The traces of a positive movement along the western coast of Corsica, and its function in the morphology and evolution of the coast-line: Paul **Castelnau.**—The telluric currents between stations of different altitude: Bernard **Brunhes.**

NEW SOUTH WALES.

Royal Society, November 4.—Mr. W. M. Hamlet, president, in the chair.—Note on pucherite from West Australia: E. **Griffiths.** The physical properties and composition of the mineral agree with those recorded in Dana's "System of Mineralogy" for the mineral pucherite. This is believed to be the first recorded occurrence of pucherite in Australia.

DIARY OF SOCIETIES.

MONDAY, JANUARY 4.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Cinchonamine and Certain Other Rare Alkaloids: B. F. Howard and O. Chick.—Reactions between Dyes and Fibres; W. P. Dreaper and A. Wilson.—A Physico-chemical Method for Comparing the Antiseptic Value of Disinfectants: Drs. S. B. Schryver and R. Lessing.

VICTORIA INSTITUTE, at 4.30.—Life in a Country Town of Lycaonia—(Conditions of Christian Life under the Eastern Empire): Sir W. M. Ramsay.

THURSDAY, JANUARY 7.

RÖNTGEN SOCIETY, at 8.15.—A Description of Three Sub-standards of Radio-activity recently prepared for the Röntgen Society: C. E. S. Phillips.—A New Localising Apparatus designed by Staff-Surgeon Dr. Gillett: H. C. Head.

CONTENTS.

THURSDAY, JANUARY 7, 1909.

ALL ABOUT WATER.

Water: Its Origin and Use. By William Coles-Finch. Pp. xxi+483; with illustrations. (London: Alston Rivers, Ltd., 1908.) Price 21s. net.

THERE is little about water on which Mr. Coles-Finch does not touch in this volume, for he even takes his readers back to the day when the world was but a glowing mist and oxygen would not have combined with hydrogen. The method has its disadvantages, though useful to anyone in want of an encyclopædic treatise, because the author has often to fall back on second-hand information, not even excluding the "science notes" of a daily journal. His manner of reference also is slipshod, for he is generally content with simply naming the author. But readers are not always trustful, and like to be enabled to consult the original passage—especially after coming across one or two rather puzzling misprints, such as Gretroz for Giétroz, Maindetta for Maladetta, Demavena for Demavend, Dun, perhaps for Dust, and Brunz (the name of a Swiss Lake), we presume for Brienz. Small inaccuracies—such motes as might so easily have been removed by inducing a friend more familiar with the scientific side of the subject to read the proof sheets—are rather too numerous. Here are a few samples. The difference between hard and soft water is said on p. 127 to consist in the relative quantities of carbonate of lime in it, yet just below come the words, "there are two kinds of hardness, permanent and temporary," the one due to the presence of calcium sulphate, the other to its carbonate. The amount of chalk in the world is probably over-estimated by forgetting that it means one, not every kind of limestone. Ice-fields are said, on p. 195, to form every winter on polar seas, but the author directly afterwards speaks of them as occurring on Iceland, and makes an extraordinary statement about those of Greenland. "The ice-fields of Greenland are beyond our comprehension; how high the plateau rises we cannot say. . . . No man has yet penetrated more than 130 miles from the west coast, where the ice is nearer the sea. It is related that explorers, after travelling 130 miles, saw a solid wall of ice 6000 feet high, and rising towards the east" (p. 195). Has he forgotten Nansen and the "First Crossing of Greenland," not to mention later explorations?

The statement about the "parallel roads" in Glenroy is confused. Also, the author is hardly justified in taking it for granted that the erratics near Wolverhampton mark the terminal moraine of a glacier, or that the Scandinavian ice-sheet successfully crossed the deep channel bordering the Norway coast, to deposit boulders at Cromer, and, as he might have added, at least as far inland as Bedford. The Lofoden Islands are hardly "a typical instance of the manner in which the sea has swallowed up the solid land" (p. 330), unless this is by submergence, which he clearly does not mean. They afford no parallel with Reculver Church. "The Lake of Campania in Italy" near Baiæ is usually called *Avernus* or Averno, and "Lake Chala on Mount Kilimanjaro" does not lie 400 to 800 feet below the summit, for, according to Meyer, Lake Jala, discovered by New, is "at the foot of Kilimanjaro on its south-eastern side." The Lago d'Alleghe in the Italian Tyrol was not formed by the terminal moraine of a vanished glacier, but by a berg fall in 1772. The height of the Lake of Geneva above sea-level is understated by about 70 feet. The maximum depths of the Lake of Constance and of the Lago Maggiore are incorrectly given. The Dead Sea can hardly be said to be "deeply embedded in lofty cliffs of limestone," and we have no reason to suppose that volcanic activity had much to do with forming the Lake of Tiberias. There is no eruption of Vesuvius on record until A.D. 79; it was an earthquake which damaged Pompeii in A.D. 63. The hippopotamus neither has a horn nor had one in the days of Palæolithic man (p. 240).

But, apart from these slips, and notwithstanding some defects of arrangement and a little too much sermonising, Mr. Coles-Finch's book contains a large amount of interesting information. We are told among the *obiter dicta* that Manchester soot comprises 50 per cent. of substances which are not carbon. Among these are "snow-white samples of ammonium chloride, ammonium sulphate, calcium sulphate, and a beautifully crystallised paraffin hydrocarbon." In fact, the heavy hydrocarbon oils in household soot amounted to 13 per cent., and Prof. E. Knecht, who analysed the material, manufactured from these components "a dye stuff which was capable of producing absolutely fast shades of brown on cotton"! We heartily sympathise with the author in his denunciation of the domestic fireplace, so much beloved in this country, for it often contributes about one-half the soot which fouls the atmosphere of London, and produces the minimum of effect at the maximum of cost. We would also gladly commit to his mercies the hooligans who wreck trees planted to adorn towns, and wilful wasters of water such as those who leave a tap running while they are away for a holiday in order to secure that their drains are scoured.

Perhaps the most valuable part of the volume is that dealing with practical matters, where Mr. Coles-Finch speaks from experience, such, for instance, as his description of a water-bearing fissure in the chalk, discovered at a depth of 120 feet while making a well at Strood for the supply of Rochester. Such fissures are, of course, well known as important sources of water supply in the Thames basin, but we do not remember to have seen in any book generally accessible plans, sections and illustrations of them.

The volume is abundantly illustrated by reproduced photographs, the majority of which have been taken in the High Alps and other mountain districts by Mrs. Aubrey Le Blond. Some of these, perhaps, are not very closely connected with the text, and Mr. Coles-Finch has too often failed to indicate by a reference the subject which a picture is meant to illustrate; but they are often so pretty as to add materially to the attractiveness of the volume; though in some, as will

happen in Alpine scenery, the rocks have come out too dark. Among the full-page illustrations, hoar-frost on a tree, a frozen lake in the Engadine, and a view at Ragaz strike us as particularly good. In fact, though the book is certainly not free from defects, it has not a few countervailing merits.

COLOUR AND PIGMENTS.

Colour-sense Training and Colour Using. By E. J. Taylor. Pp. 88. (London: Blackie and Son, Ltd., 1908.)

THIS should prove a very useful little book to teachers who wish to explain the fundamental laws of colour to their pupils. The old division of the spectrum into the three primaries blue, yellow and red—still persists among artists and leads to much confusion of thought, and doubtless a book of this character will assist in bringing in a truer perception of the nature of colour-vision, while it is not so difficult as Prof. Church's book or Sir William Abney's "Colour Measurement and Mixture."

The author in dealing with this subject takes the ordinary Young-Helmholtz theory of the primary colour sensations, and is quite right in so doing. It is simpler, and at any rate covers most of the facts, and there is no need in a book of this character to discuss any rival theories which may exist. The weakest chapter in the book is that dealing with the mixing of pigments, and in a future edition this chapter might well be re-written and developed. One of the most important lessons the artist can learn from the study of the theory of colour is the extent to which he can limit his palette and get all the effects he requires. For instance, by means of a rich madder, cobalt yellow, viridian, and cobalt blue, every tint can be obtained, including a deep, rich, velvety black, while a complete spectrum can be constructed on a lower key by the use of black, Indian and Venetian red and yellow ochre, and it is therefore of great importance that the art student, having once mastered the theory, should test it by experiments with a few selected pigments, and should realise for himself that lampblack and yellow ochre really give a green, and that he can get practically a complete absorption of the spectrum from not more than three or four pigments.

It is also of importance that he should be trained to use a palette consisting of permanent pigments, and should avoid as far as possible those that are fugitive. It is therefore a pity to see in a modern text-book an artist advised to use such pigments as crimson lake, carmine, indigo and gamboge. These should all be excluded. The writer has also apparently not realised the extent to which his theory will assist the artist who wishes to paint in the method of the French impressionist school by the juxtaposition of small dots of colour instead of by an actual mixing of the pigments. If, for instance, blue and yellow are painted in small dots side by side, from a little distance the effect is to give a grey and not a green; in fact, green is the one colour which cannot be produced by such juxtaposition of pigment, but must be obtained either by the use of a green pigment or the mixing of a blue and yellow so as to leave the net result of their mutual absorptions. A short discussion, therefore, of the French method of painting as opposed to the method of mixing pigments, and a statement of the actual results obtained by the blending in the eye of the lights reflected from two separate pure pigments painted side by side, would be of great value to the modern artist. Most of our painters to-day make use of both methods to get their effects, and would probably be much helped by being taught a few fundamental principles. The only reference which the author has to this method of painting is to be found on p. 60, where he says the designers avoid dirty tones by placing the pigments very close, with the alternate colours in dots and dashes, but he does not seem to realise that the resulting colour may be quite different from that obtained by blending the pigments.

There is another difficulty which faces the artist in dealing with actual pigments, and which has not been discussed by the author. Many when mixed with white completely alter in tint, and the matter is not so simple as it would appear from the description in the text of the graded tones to be obtained in this way. To take a simple instance, the great value of yellow ochre to an artist is that it can be mixed with white without an alteration in the tint, so that the yellow ochre let down with white has the same colour value to the eye. This is not true of most other yellows, and consequently yellow ochre is invaluable for producing the effect of bright sunlight falling on a white surface. With reference to the training of children in the meaning of colour, it is open to question if the modern kindergarten methods are wise. The colours which are used in practice for training young children, and from which they are supposed to build up various patterns, are remarkable for their peculiar ugliness and the hideous colour schemes which result from them. Children grow up with a beautiful perception of true colour schemes in many lands where the kindergarten methods have never been heard of, and one of our greatest difficulties at present is that those engaged in trade processes which involve the use of colour have no fine sense of what is beautiful. It is surely an open question whether the hideous colours presented to very young children in the kindergarten classes are not positively injurious, and tend to destroy any instinctive taste for colour with which they have been endowed by nature.

THE ATLAS OF CANADA.

Atlas of Canada. Prepared under the direction of J. White. Pp. 21; 83 plates. (Canada: Department of the Interior, 1906.)

THIS atlas, which has been compiled with great care, shows, in a form which can usually if not always be easily comprehended, much of the information which is at present obtainable concerning the Great Dominion. It contains about forty maps, and rather more than that number of plates of diagrams.

Regarding the arrangement of the maps it is unfortunate that some method more in agreement with the principles of geographical development has not been followed; why the distribution of telegraphs and telephones should precede that of temperature and rainfall is not easy to understand. In a few cases also the maps might have been improved; it is to be regretted, for example, that some other method than that chosen was not adopted to show the physical features of the land, at least in the better-known parts of the country. To mark everything above 2000 feet in height in one of three shades of brown results in a map which is decidedly wanting in plasticity. The map showing drainage areas would also have been rendered more effective had it been printed in different colours.

The greatest defect, however, in this part of the atlas is the absence of a few maps illustrating and explaining the development of agriculture in Manitoba, Saskatchewan, and Alberta. The value of the book would have been enhanced by the introduction of some maps similar to those which accompanied Prof. Mavor's report to the Board of Trade on wheat-growing areas in Canada, showing the regions in which the cultivation of wheat is considered possible, the districts in which it is at present grown, the lands which have so far been occupied, &c.

Considerable attention has been paid to meteorology, and some valuable information is given. Besides the isothermal charts, which show temperature reduced to sea-level, and are therefore not particularly illuminating at first sight, in the case of Canada there are several interesting maps showing the number of days during the year in which the temperature is above 32°, 40°, 50°, 60°, and 70° respectively. It is to be hoped that in the course of time it will be possible to verify and extend this information, which is likely to be of great value in Canada, where it is directly connected with important agricultural problems. Unfortunately, we are not told over what period the observations have extended. Space will only permit us to remark that among the remaining maps there are several interesting ones showing the international boundary at various places, and several which show the railways of Canada, completed or projected, along with the sphere of influence of each system. To many of the maps also are appended useful tables of statistics.

That part of the atlas which is occupied by diagrams contains a great deal of valuable information, information of a kind, however, which in the case of a country like Canada begins to be out of date even before the publication of the work in which it is contained. Nevertheless, it suffices to show that within recent years the progress of Canada has been, on the whole, steady and continuous, even although the complete story of its development is not told here. A few examples will illustrate this. The occupied land has increased from 36,000,000 acres (of which 17,000,000 acres were "improved") in 1871 to 63,000,000 acres (of which 30,000,000 acres were "improved") in 1901. The wheat area has been largely extended, though we miss a few diagrams which would have made the extent of this increase visible at a glance.

The exploitation of the mineral wealth of Canada has increased very rapidly within the last twenty years, and is still increasing, notwithstanding the greatly decreased amount of gold which has been produced within the last few years. Regarding the forest products of the country, further information would have been welcome, and the same is true with regard to manufactures. The figures and diagrams which are given under this last head show that the capital invested had increased from 80,000,000 dollars in 1871 to 450,000,000 dollars in 1901, while the number of employees had risen from 180,000 to 313,000 during the same period. (The diagrams, however, do not make it clear how far these figures are comparable.) The chief manufacturing province is Ontario, while Quebec takes second place, and the remaining provinces are of less importance.

The most striking fact brought out by the series of diagrams on the foreign trade of the country is the extent to which the United States is taking the place of Great Britain as the chief importer into Canada. While Canada still sends more of her goods to this country than she does to the States, the latter country supplies her with more than twice the amount that Britain does. The latest figures given are for 1904, but since then the advance of the United States has been continued.

A number of diagrams deal with population in various aspects. One of these shows the distribution of males and females in the different provinces, and incidentally throws light on the conditions of life in different parts of the country. In British Columbia and the Territories, men outnumber women considerably; in Manitoba, Saskatchewan and Alberta to a less extent, and elsewhere only very slightly. The death-rate in all the provinces is less than the average for the British Isles, except in the case of Quebec, where it is higher. In 1891 Quebec was the most illiterate of all the provinces, but the large immigration from the continent of Europe during the following ten years has led to that position being taken by Alberta and Saskatchewan.

There is much in the atlas which it is impossible to touch upon in this review. We can only express our gratification that the Canadian Government has seen its way to publish so important and valuable a work, and hope that the Governments of other countries may follow in its steps.

ANIMAL HISTOLOGY.

A Text-book of the Principles of Animal Histology. By Ulric Dahlgren and Wm. A. Kepner. Pp. xiii+515. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.) Price 16*s.* net.

IN many respects Messrs. Dahlgren and Kepner's "Principles of Animal Histology" may be regarded as a decided advance on the current text-book. It is no mere compilation; its method of treatment is novel, the subject-matter embraces a considerable amount of new and original work, and it presents a wider view of histological study than any previous treatise on the subject.

The scheme of the book is the study of structure

based on functional value, the functions of the various tissues and organs being discussed as an introduction to their intimate structure. The scope is necessarily a very wide one, and as a consequence the description of detail is in many cases limited, and in some cases tends to obscurity.

The authors confine their aim to general principles which shall serve as a broad foundation for further studies (*vide* preface). The treatise, however, is better adapted as a reference book for the more advanced student who has already some acquaintance with histological detail than as a guide to one commencing its study.

Although the function of the structure is the key-plan of the work, insufficient force is given to the mutual interdependence of the two, the significance of a structure as a functional adaptation being frequently lost sight of. The statement in the preface that "all structures exist only for the purpose of performing certain functions in some particular way" is dangerous and open to misinterpretation, while the statement in the text (p. 185) that nerve cells of a size beyond a definite limit "are obliged to develop in their cytoplasm a set of channels that will serve to increase the power of nutritive exchange" is open to more than criticism, and is misleading to a degree.

The various theories as to the intimate structure of protoplasm are fairly well given, but it is not made sufficiently clear that the hypothetical structure of protoplasm is largely founded on the examination of dead tissue, and that the appearances presented by tissues which have been treated by hardening and staining reagents may give a very inadequate picture of living matter.

Electrical and light-producing organs are dealt with in chapters replete with instruction and teeming with interest, but the treatment of gas and heat production is not so satisfactory. It is not sufficiently insisted upon that the production of heat is a necessary concomitant of most metabolic processes, while it is pushing the processes of *secretion* too far to suggest that heat is to be regarded as the outcome of certain specialised granules for which the term "thermochondria" is proposed (p. 141), or that the gas which fills the swim-bladder of a teleost fish first appears in special gas-secreting cells in the form of granules (p. 334).

Chondrostosis involves a bewildering succession of complicated changes, a convincing account of which has yet to be written. A perusal of its description in the work under notice (p. 70) will not bring confused ideas into order. The changes taking place are described as a *transformation* of hyaline cartilage into bone, that the process is fundamentally neoplastic not being recognised. The statement that "when ossification begins a vascular loop enters the bone bringing with it the various bone-making cells" endows the blood-vessel with a potency of active migration which it certainly does not possess; the so-called vascularisation of the cartilage certainly involves an active migration of cellular tissue, but the vessels which appear therein undoubtedly develop *in situ*. A description of the intermediate stage, the formation of a temporary metaplastic bone represented by the calcification of the cartilage, is omitted, the deposition of the lime salts being entirely ascribed to the osteoblasts. That the bone formation begins in the middle of the "joint" of an embryonic finger is a novel use of the term joint; it is perhaps popularly correct, but not to be expected in a scientific text-book as a term defining a digital segment. Bone, it is stated, can be formed in the connective tissue, but no account is given of parostosis, and this omission is a serious one.

Vertebrate histology, on the whole, receives scant treatment, and this will be felt in studying the abbreviated descriptions of the retina (p. 255 *et seq.*), the organ of Corti (p. 221), and the organs of digestion (chapter xv), but the authors hint that such matters are adequately dealt with in medical text-books, and this relative deficiency is more than compensated for by such able and comprehensive contributions as the sections dealing with nephridial tissues, mechanical protection, poisonous fluids, &c.

The book is richly illustrated; the figures, for the most part in black line, are exceedingly clear and instructive, and add vastly to the value of the work as a whole. Many of the illustrations are original; others are selected from well-known sources with a wise discrimination.

The chapter on "technic" (!), although very abbreviated, gives a good practical outline of general methods of hardening and staining, but the suggestions, scattered throughout the text, as to the methods for elucidating the details of special tissues are scanty in the extreme, and of no practical value.

The whole bibliography is slender; the authors seem to have relied largely on the results of their own original research; this, however, adds greatly to the intrinsic value of the work. Typographical errors are numerous; "Haidenhain" in the text, and the titles of French and German papers quoted on pp. 166, 173, 501, &c., stand in need of correction.

With some amendments in the text, a few more details concerning the preparation of tissues for examination, and a more complete bibliography, Messrs. Dahlgren and Kepner's treatise will prove an invaluable addition to the library of the biologist.

INDIAN WILD-FOWL.

The Indian Ducks and their Allies. By E. C. Stuart Baker. Pp. xi+292; illustrated. (Bombay: Natural History Society; London: R. H. Porter, 1908.) Price 2*l*. 2*s*. net.

THE enormous flocks in which many members of the duck tribe visit the plains of India during the cold season, coupled with the relatively large number of species by which the group is there represented, affords ample justification for the issue of this handsome and superbly illustrated volume. For these swarms of ducks, geese, swans, and mergansers naturally attract the attention of a host of sportsmen, many of whom are anxious to identify the species of the birds which go to form their bag, and ascertain something about their natural history. Neither is the

book of less importance to the ornithologist—either professional or amateur—for Mr. Stuart Baker has much new matter to record concerning many of the species passed under review, while the thirty coloured plates—reproduced from sketches by Messrs. Grönvold, Lodge, and Keulemans—have a distinct scientific value of their own, altogether apart from their beauty as works of art.

The origin of the book dates from 1896, when the author was asked to communicate a series of illustrated articles on Indian ducks to the Journal of the Bombay Natural History Society which should incorporate the numerous notes on the group published in the Indian scientific journals and sporting papers since the issue of Hume and Marshall's well-known "Game-birds of India." These articles were commenced in the eleventh volume of the aforesaid serial, and the work now before us is a reprint of the series, with such additions and emendations as were necessary to bring them up to date.

Apart from the flamingoes, which are brigaded with the ducks under the general title of "Chenomorphæ," the author recognises no fewer than forty-three representatives of the group as visiting or permanently residing in India. He is, however, somewhat of a "splitter," and certain of his species, as in the goose-section, would very probably be relegated to a lower grade by many naturalists. We are also inclined to disagree with his views as to the multiplication of generic groups. The division of the flamingoes into two genera, and likewise the splitting of the brent-geese into Rufibrenta and Branta, are examples of what appears to us totally unnecessary complication in this matter. The author has, however, taken Count Salvadore's British Museum catalogue of the group as his guide, and he has adhered religiously to the classification therein adopted. We confess to a feeling that it would have been better to follow the late Dr. Blanford's volume in the "Fauna of British India," whereby greater simplicity would have been secured, and at the same time some advance made towards uniformity in the names of Indian animals. In this connection we may note the urgent need of a proper table of contents at the commencement of the volume, the one which does duty therefor being too absurd for words, two out of its half-dozen items being "title-page" and "contents," while a third is "Indian Ducks."

For a book which must be largely patronised by sportsmen (if it is to make a profit), we also venture to think that too many technical terms, or definitions, are introduced without any sort of explanation. What, for instance, will the sportsman (or, for that matter, the amateur naturalist) make of the bald statement that the Chenomorphæ are characterised by having the "palate desmognathous," or what will he understand by the "neotropical region"? If such expressions are used at all, they ought to be adequately explained; but in our opinion they are altogether out of place in a work of this nature; the professional naturalist does not want them, and the amateur and the sportsman do not understand them. In the place of the former a statement to the effect that the palate in the dry skull is of the closed or bridged type, and that the difference between the bridged and the open or slit type may be realised by comparing the skull of a duck with that of a fowl, would have been much more to the point; while as regards the latter it would have been infinitely better to use the ordinary names, South and Central America, in place of neotropical region.

With these exceptions—if it be added that the author has an extremely old-fashioned and obsolete way of spelling Indian place-names—we have nothing but commendation for the volume before us, the species being clearly and carefully described, with full and well-written notices of their distribution and habits. As Mr. Baker observes, the collection and collation of a vast amount of scattered information concerning the Indian Anatidæ renders it from the first possible to know the extent of our information on the subject, and to realise what gaps require filling up. The book should be in the library of every Indian sportsman, by whom it should be taken into camp in each winter's sporting trip.

R. L.

BIOCHEMICAL MONOGRAPHS.

The Nature of Enzyme Action. By Dr. W. M. Bayliss, F.R.S. Pp. ix+90. (London: Longmans, Green and Co., 1908.) Price 3*s.* net.

The Chemical Constitution of the Proteins. By Dr. R. H. Aders Plimmer. In two parts. Part i., pp. xii+100; part ii., pp. xi+66. (London: Longmans, Green and Co., 1908.) Part i., 3*s.* net; part ii., 2*s.* 6*d.* net.

Neuere Ergebnisse auf dem Gebiete der speziellen Eiweisschemie. By Emil Abderhalden. Pp. 128. (Jena: G. Fischer, 1909.) Price 3.50 marks.

Intracellular Enzymes. A Course of Lectures given in the Physiological Laboratory, University of London. By Dr. H. M. Vernon. Pp. xi+240. (London: John Murray, 1908.) Price 7*s.* 6*d.* net.

THE number of books issued in any particular subject is not always a sure criterion of the importance of that subject. In this particular instance, however, where a shower of five monographs has suddenly fallen, not only is the interest which biochemistry is at present attracting indicated, but a perusal of the books themselves shows that they deal with a subject of supreme importance both to the chemist and to the biologist.

The first three on the list, that by Dr. Bayliss, and the two parts from the pen of Dr. Plimmer, are monographs which are being issued under the joint editorship of Dr. F. G. Hopkins, of Cambridge, and Dr. R. H. Aders Plimmer, of University College, London. To some extent the idea is similar to that underlying the issue of the "Ergebnisse der Physiologie" in Germany, only with this important difference, namely, that the individual monographs or chapters (each written by someone who is master in that particular subject) are issued independently of the others, so that if necessity arises a new edition of any

one of them can be printed without re-issuing the whole series. The rate of progress now being made in biochemical science is so rapid that this method of publication is the best that can be adopted for keeping abreast of increasing knowledge; and, in addition to this, those interested in any particular subject will be able to obtain the latest information at minimal expense.

Dr. Bayliss's essay on enzyme action is a fitting introduction to the series, not only because of its excellence, but also because it is becoming recognised that the action of ferments lies at the root of biochemical actions. Outside the living organism the same chemical changes can be made to occur, but only, as a rule, at a high temperature or by the aid of powerful reagents. In the body, the changes are produced at body temperature with far greater rapidity, and in the presence of moderate concentrations of acid or alkali. The enzymes responsible for this action are catalysts; that is to say, their presence induces a rapidity in the chemical transformation of the substances they come in contact with, in a manner analogous to that seen in the action of inorganic catalysts. Any deviation from the laws of catalytic phenomena which they exhibit depends upon the colloidal nature of the enzymes. This statement gives in brief the gist of the book. Such questions as the reversibility of ferment action, the nature of the compound between enzyme and substrate, and autocatalysis both positive and negative are also discussed, the whole forming an up-to-date, clear and readable exposition of our knowledge on this most important subject, a subject which Dr. Bayliss's own original work has done so much to elucidate.

Dr. Plimmer's work is a brief and masterly exposition of the present state of protein chemistry, and is most appropriately dedicated to Prof. Emil Fischer, whose epoch-making discoveries have done so much to render clear what before was so obscure. In the first of the two parts, the protein molecule as a whole is first examined, and then the individual amino-acids which form its constituent units are treated, and finally, in the second part, the attempts made by Fischer and his colleagues to build albumin from its constituent bricks are described. It is in this last aspect that the subject is least complete, because, although Fischer has been successful in forming short linkages of amino-acids which he terms polypeptides, and although some of the longer chains he has constructed bear a close resemblance to the peptones, it is well known that his ultimate aim, the synthesis of albumin itself, has not yet been realised. One cannot, however, doubt that this culmination of his work is only a matter of time.

Prof. Abderhalden, in his monograph, traverses much the same ground. He has been Prof. Fischer's right-hand man throughout his arduous work, and so is well fitted to expound it. His pamphlet is a reprint of the chapter he has written on the subject in Karl Oppenheimer's "Handbuch der Biochemie," which is now issuing from the press.

It must not be supposed that either Dr. Plimmer's or Prof. Abderhalden's contributions to the subject cover the whole ground. In Oppenheimer's handbook there are several other chapters on the proteins which deal with them from other points of view. There is, for instance, their importance from the biological side, and the *rôle* they play in life and in the metabolism of living cells. But before it is possible to understand that to the full, the chemistry of the protein molecule must be understood first. That is the foundation upon which the biologist must build, and that is the reason why so many researchers are spending their lives on the purely chemical aspect of this most important question. Proteins are the most abundant of the constituents of protoplasm; they are always present and never absent, and so far no other laboratory has succeeded in constructing them but the laboratory of the living cell. Chemists and biologists alike, however, are beginning to doubt whether proteins are exclusively endowed with the properties we term vital, and are beginning to direct their attention to some other substances which are universally present in protoplasm, and which manifest the character of lability to an even greater degree than do some of the proteins. These substances are termed lipoids, and cholesterin and lecithin may be taken as examples of the class. As a rule they are present in much smaller quantity than are the proteins, but they appear to be an indispensable part of the living molecule.

In Dr. Vernon's little book we return once more to the question of enzymes. It is the seventh of a series of books which Mr. Murray is issuing under the auspices of the University of London; like the others, it is the outcome of a course of lecures delivered in the physiological laboratory of that institution, and it will compare very favourably with its predecessors.

As already stated, it is becoming more and more clearly recognised that the activities of living protoplasm are bound up with the activities of ferments, the complex organic keys which are able to lock and unlock the unions between the elaborate molecular groups of which living material consists. The action of extra-cellular enzymes, such as pepsin and trypsin, which do their work outside the body-cells, has been familiar for many years. So also is the enzymatic activity of such micro-organisms as yeast and bacteria. But the conception that metabolism in the higher organisms is mainly the result of ferment action in their cells is a comparatively new aspect of the subject, and consequently the one in which the gaps in our knowledge are the most numerous. Dr. Vernon himself, by his original work on autolysis, on tissue erepsin, and other ferments of similar nature, has done a good deal to bridge over these intervals, and is therefore well fitted to lecture upon and write about the subject in a systematic manner. The book that he has produced is eminently readable and highly instructive, and its perusal should be thoughtfully undertaken by all those interested in the mechanism of the many problems presented to the student of animal and vegetable life.

W. D. H.

ELEMENTARY MATHEMATICS.

(1) *Elementary Solid Geometry, including the Mensuration of the Simpler Solids.* By W. H. Jackson. Pp. xii+159. (London: Edward Arnold, 1907.) Price 2s. 6d.

(2) *Euclid Simplified in Accordance with the New University Regulations, with Additional Propositions and Numerous Examples.* Fourth edition. By Saradaranjan Ray. Pp. xvi+271. (Calcutta: The City Book Society.) Price 1.8 rupees.

(3) *A Preliminary Geometry.* By Noel S. Lydon. Pp. iv+108. (London: Methuen and Co., n.d.) Price 1s.

(4) *Examples in Elementary Mechanics, Practical, Graphical, and Theoretical.* By W. J. Dobbs. Pp. xii+344. (London: Methuen and Co., n.d.) Price 5s.

(1) THE study of three-dimensional geometry is generally more or less neglected in our schools; this excellent text-book should materially help to correct this fault; its effect on the reader is to enhance his sense of the importance and attractive nature of the subject. In part i. the properties of the line and plane and of the simpler curved surfaces are demonstrated with Euclidean rigour, but with a delightful freshness which recent reforms have done so much to encourage. Moreover, the numerous and well-chosen exercises, and the admirable figures and diagrams, are quite a feature of the book. Part ii. deals with the mensuration of solids. It is as effective as before; in style and treatment and in the diagrams and exercises the same high standard is maintained. Prof. Horace Lamb has written an appreciative preface, and there is no book on this branch of mathematics more worthy of adoption in our schools and colleges.

(2) In this geometry, in order to preserve continuity and for convenience of reference, the sequence and indeed the numbering of Euclid's propositions are maintained, while the arrangement is designed to meet the requirements of the new syllabus of geometry for the matriculation examination of the Calcutta University, which will be found very similar to the schedules now prevailing in this country. In remodelling Euclid according to this scheme, propositions of minor importance are relegated to the exercises, and new propositions are added. The enunciations and proofs are revised and often rewritten. Many exercises are provided. The book will appeal to those who wish to follow the new methods with as little departure from the old as possible, and who are not prepared to accept the reform in its entirety.

(3) This useful little book gives a simple and orderly course of practical geometry for beginners, intended as a preliminary to a formal and deductive study of the subject. The pupil becomes acquainted with the terminology and with the properties of the simpler plane figures, and to some extent is trained to use his reasoning faculties. The author is very successful in carrying out his scheme.

(4) The distinction between theoretical and applied mechanics is gradually losing its significance, and it is now generally recognised that the subject of mechanics cannot be satisfactorily taught without some amount of experimental and practical work done by the student himself. The present book is written from this point of view; the graduated series of examples, arranged in chapters, are experimental, numerical and graphical, and are accompanied by just sufficient explanation and discussion of principles as, with the guidance of a teacher, will enable the student to dispense with an ordinary text-book. The apparatus used, while effective for its purpose, is of the simplest character, and is for the most part made by the student himself. Statics is fully discussed before dynamics is taken up, a sequence which, we think, is the right one. The conception is good and well worked out, and the book will commend itself to many teachers.

TWO SPECULATIVE CONTRIBUTIONS TO GEOLOGY.

Die Entstehung der Kontinente, der Vulkane und Gebirge. By P. O. Köhler. Pp. vi+58; 2 figures. (Leipzig: W. Engelmann, 1908.) Price 1.60 marks.

Die geologischen Grundlagen der Abstammungslehre. By G. Steinmann. Pp. ix+284; 172 figures. (Leipzig: W. Engelmann, 1908.) Price 7 marks.

THESE two books have little in common except that they are both German speculative discussions of geological principles. Herr P. O. Köhler's pamphlet on the origin of continents, volcanoes, and mountains is a contribution to dynamical geology, in which he rejects some of the most generally accepted facts in geological morphology, and opposes especially some of the main conclusions of Prof. Suess. The author denies the existence of "Senkungsfelder," or foundered blocks of the earth's crust, and he declares that raised earth blocks—the Schollen of Suess—are statically impossible. Herr Köhler regards plutonic and volcanic intrusions as closely allied, and attaches great weight to the extent of plutonic activity; he describes the views of those whom he calls the "passive plutonists" as erroneous in all important respects, and he traces their errors to two chief fallacies—the secular cooling of the earth and its higher internal temperature.

Prof. Steinmann's book is a bold attempt to reclassify the animal and vegetable kingdoms. He advocates principles which, if not altogether new, have long been out of fashion and lead to startling and incredible results. Twenty years ago Prof. Steinmann was driven to study the bases of the current theory of phylogeny, as it would not fit the facts; and in this volume he gives a most interesting sketch of the history of the subject, followed by a statement of the principles and results obtained by his own long studies. Most palæontologists share Prof. Steinmann's faith in the importance of the historic evidence. The positive records of geology as to the succession of life on the world afford the ultimate test by which all theories of evolution must be judged. A sufficient volume of evidence may not be collected

for several generations, but when it comes its conclusions will have to be accepted, for it consists of the actual facts as to the development of life on the globe. The weight assigned by Steinmann to the value of the historic method is not exaggerated, but his methods of using it are open to question.

He advances two main principles, racial immortality and the primary importance of external characters. He emphatically denies the current belief that whole classes of animals and plants have become extinct. He says groups of animals always survive, though we fail to recognise the connection between successive generations. That organic variation should never have followed unsuitable directions and that there are no dead ends in the tree of life is a startling doctrine. This principle of racial immortality leads Prof. Steinmann to conclusions which are not likely to be generally accepted. The trilobites, according to his views, must have lineal descendants, and he finds that various insects are the progeny of different families of trilobites.

Prof. Steinmann's second principle is equally revolutionary. He holds (p. 119) that "for phylogeny the most significant characters are sculpture and form." Engineers have been driven to give torpedoes shapes which resemble those of some sharks, some Mesozoic marine reptiles and whales. This external similarity is usually regarded as an adaptation to the physical necessities of rapid progress through water; but this homoplastic explanation is rejected by Prof. Steinmann. In accordance with his view that form and sculpture are the best guides to relationships, he maintains that the whales are the direct descendants of Mesozoic reptiles. The numerous characters in which the Cetacea agree with mammals and differ from reptiles Prof. Steinmann dismisses as of secondary importance, and as due to a sort of zoological fashion. He maintains that their external resemblances show that the various Cetacea are derived from various groups of reptiles. The Delphinidæ (dolphins and porpoises), according to Steinmann, are the descendants of the Ichthyosaurians, the sperm whales of the Plesiosaurs, and the whalebone whales of such reptiles as Clidastes and Mosasaurus. Similarly, he derives the Casuaries from Ceratosaurus, the Patagonian Miocene bird Phororhacos from Belodon, and the walrus from Dinoceras.

Prof. Steinmann's views as to the relationships of various invertebrates and plants are equally startling. The tunicates he represents ingeniously as shell-less descendants of the Rudistidæ, and the characters believed to connect the ascidians with the ancestors of the invertebrates, he says, are of secondary importance, and have been recently acquired.

Prof. Steinmann has done such valuable work both in palæontology and geology that his views are always entitled to careful consideration; but he must not be surprised if the arguments in his present essay are generally dismissed as unconvincing, for they require the re-classification of both animal and vegetable kingdoms on lines which have been almost unanimously rejected by modern biologists.

J. W. G.

OUR BOOK SHELF.

Das Gebiss des Menschen und der Anthropomorphen. Vergleichend-anatomische Untersuchungen. Zugleich ein Beitrag zur menschlichen Stammgeschichte. By Dr P. Adloff. Pp. 165; 9 text-figures, 27 plates. (Berlin: Julius Springer, 1908.) Price 15 marks.

THIS excellent book is part of the literature of an arduous if somewhat wordy warfare concerning the genealogy of mankind in general and of that variety in particular known as the "Neanderthal" or "Spy" man which broke out some years ago amongst the anatomists along the Rhine valley, and, as this work shows, is still being carried on with great vigour. The outbreak was really a consequence of the discovery of *Pithecanthropus erectus* by Eugène Dubois in 1894. In the light of that discovery, Prof. Schwalbe, of Strassburg, commenced a critical re-examination of the remains of the Neanderthal-Spy race, and came to the conclusion that they could not be regarded as ancestral to modern Europeans owing to their many physical peculiarities, and that they constituted a species of mankind, to which the name *Homo primigenius* was applied.

Prof. Kollmann, of Basel, slighted the specific marks assigned by Schwalbe to *Homo primigenius*, and set out to find the ancestry of modern man in a race of pygmies, with as yet but little success. Then came the discovery of the Krapina men in Croatia by Gorjanović-Kramberger, with teeth belonging to some ten individuals in excellent preservation, and of a type almost unknown among modern men. While the discoverer regarded the Krapina men as mere variants of modern man, Adloff excludes them from the ancestry of modern Europeans, and gives them the specific name of *Homo antiquus*.

The discussions and the disputes have been widened by the Dutch anatomists, Klaatsch (now in Breslau) and Bolk, of Amsterdam, the first of whom upholds the theory that man and anthropoids have sprung independently from a lemuroid stock, while the second maintains that the old-world apes and monkeys are derived from a stock akin to the South American monkeys. It was to clear up the points in dispute that Dr. Adloff produced the work under review; but it is to be feared their settlement is as far off as ever. Dr. Adloff has made a special study of teeth and has taken much pains to obtain access to all available material. He has described and figured all he has seen with accuracy, and thus produced a work which must prove of the greatest value to all who are investigating the problems connected with the origin of man. The facts will stand, but it is to be feared that most of the author's inferences are not of an abiding value. The discussion has scarcely received the attention it deserves in England; the present position of matters may be gleaned from this work.

A. K.

The Hope Reports. Vol. vi. (1906–8). Edited by Prof. E. B. Poulton, F.R.S. (Oxford: Printed for private circulation by H. Hart, 1908.)

THE memoirs contained in the bulky sixth volume of the Hope Reports were published separately in the course of the two years from June, 1906, to June, 1908. They bear eloquent witness to the quantity and quality of work which is being turned out by the Hope Department of Zoology in the University of Oxford. The first ten memoirs are chiefly or wholly concerned with bionomic subjects—*e.g.* particular cases of mimicry sometimes studied on the spot, the recent developments in the theory of mimicry, experiments on seasonally dimorphic forms, the natural

attitudes of rest in British moths, predaceous insects and their prey. A subject like the last, for instance, worked out by the cooperation of many naturalists, commends itself as zoological work of the soundest sort; it brings together a mass of trustworthy information in regard to insect natural history, it has an obvious bearing on the theory of selection, and it makes towards supplying a trustworthy basis for practical measures. Three of these interesting bionomical memoirs are contributed by Dr. F. A. Dixey, two by the Hope professor, and one each by Messrs. T. R. Bell, A. H. Hamm, S. L. Hinde, W. J. Kaye, and S. A. Neave. Three papers by Dr. Longstaff contain records of observations—chiefly bionomic—on insects met with in various parts of the world. Then follow papers, chiefly of a systematic nature, on Blattidæ by Mr. R. Shelford, on "grasshoppers" by Dr. J. L. Hancock, on beetles by Commander J. J. Walker. After these the volume ends, as it began, with bionomical inquiry, from which modern entomologists are seldom far away. We cannot look over a volume like this (reviving our recollections, in some cases, of papers we had read before) without feeling afresh that the entomologist, more, perhaps, than most naturalists, has his finger on the pulse of evolution. The Hope Reports show that he is not unaware of his great opportunities.

Calcul graphique et nomographie. By M. d'Ocagne. Pp. xxvi+392+xii. (Paris: Octave Dion, 1908.) Price 5 francs.

THE "Encyclopédie scientifique" of which this book forms one volume is intended ultimately to consist of 1000 volumes divided into 40 sections, written by specialists in different sciences, and edited by Dr. Toulouse. While aiming at the completeness of an encyclopædia, it differs from most publications bearing that name in that it consists of small volumes, each treating of one subject, instead of bulky volumes, each containing a number of widely diverse articles.

In this volume M. d'Ocagne deals with graphical methods of computation, a subject in the development of which he has himself played an important part. It is pointed out that such methods are sufficiently accurate for the solution of most problems, financial calculations and certain geodetic operations constituting an exception, though even in these graphic methods may play an important part. The first part of the book deals with graphical algebra and graphic methods of integration, the second with nomography. The latter subject is treated from two points of view, between which a kind of principle of duality exists—the method of concurrent lines, and the method of collinear points. In the former the relation between three variables is determined by the intersection of the lines corresponding to constant values of the respective variables; in the latter three straight or curved lines are scaled, and the simultaneous values of the variables are represented by collinear points on the scales which can be read off by laying a ruler across them. In Prof. d'Ocagne's hands this method has effected quite a revolution in simplifying numerical approximations, and it has the merit of being easily extended to more than three variables.

Mythenbildung und Erkenntnis. By G. F. Lipps. Pp. viii+312. (Leipzig: B. G. Teubner, 1907.) Price 5 marks.

THIS is an interesting contribution to the literature which in recent times has been filling up the gap between mathematics and philosophy. In it the author traces the origin of mythical superstitions in primitive races and their subsequent replacement by the critical methods of exact analysis. He further discusses the application of symbolic methods to the representation of phenomena connected with the universe, with existence, and with thought. The book forms a suitable sequel to Poincaré's "Science and Hypothesis," and is published in the form of the third of a series of books bearing the title of Poincaré's volume. While covering a somewhat different field, Dr. Lipps's method of treatment is more constructive in character. He has attempted to build up a connected theory rather than to ask the invariable question, Why?

The Old Yellow Book. By Charles W. Hadell. Pp. viii+cclxii+345. (Washington: Carnegie Institution, 1908.)

THE first part of this large volume consists of a complete photographic reproduction of the "Yellow Book," now in the library of Balliol College, which formed the theme of Browning's poem, "The Ring and the Book." This is followed by an English translation, as well as translations of two other sources of information relating to the Franceschini murder case, and an essay by the author on "The Making of a Great Poem." The photographic reproductions, as the author points out, are of first importance to secure the scholarly world against the possible destruction of the unique copy in Balliol College. At the same time, seeing that a few blemishes, due to creases in the original book, have been removed, and that the pages have been re-numbered, it seems a pity that the present book was not properly guillotined before being issued to the public.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

On the Magnetic Action of Sun-spots.

IT was perhaps to be expected that the recent discovery of the Zeeman effect in the spectra of sun-spots should revive the idea of a direct magnetic action originating in the sun and observable at the surface of the earth. A numerical estimate is therefore called for as to the magnitude of the disturbance which might be produced by such a direct action.

A solar vortex involving electric circulation, and consequently magnetic fields, will be most favourably placed to produce magnetic action if its apparent position is at the centre of the solar disc. If we consider the disturbed area, which for convenience I shall call the spot, as a magnetic pole, the first question that arises refers to the whereabouts of the opposite pole. We may place it at the further end of the solar diameter passing through the spot, and thus again assume the most favourable conditions. If, now, the vertical forces on the solar surface are treated as made up of a series of spherical harmonics, we need only consider the first term from which forces varying inversely as the cube of the distance are derived, because the numerical values of the forces derived from the higher terms are, at the distance of the earth, at least a hundred times weaker. Write, therefore, for the vertical force F

$$F = B\mu + \text{higher terms},$$

where μ is the cosine of the solar co-latitude measured from the spot.

The coefficient B is determined in the usual way by

$$\int_{-1}^{+1} F\mu d\mu = \tfrac{2}{3}B.$$

As the spot is confined to a small region, for which $\mu = 1$, and F has only finite values over this region and at the opposite pole, we may for the left-hand side of the

equation substitute $2Fa$, where a is the area of the spot measured in terms of the solar hemisphere. This leads to

$$B = 3Fa.$$

The vertical force will not be constant over the whole spot area, but we may now take F to be the average vertical force, and its variations are immaterial when it is only a question of evaluating the order of magnitude of the effect. At the distance of the earth the corresponding force acting in a direction radial from the sun is equal to $3Fa\alpha^3$, where α is the angular semi-diameter of the sun as viewed from the earth ($\alpha^3 = 10^{-7}$).

If we adopt Zeeman's estimate of 3000 C.G.S. for F, the only remaining quantity to be estimated is a. We may take account of the greatest possible collective effect of all spots by imagining them all of the same polarity and placed at the centre of the solar disc; a then represents the total spotted area which may be obtained by reference to the Greenwich tables. If we include in the spot area the penumbra as well as the umbra, we find the average value to be about 500 in millionths of the sun's hemisphere, but in years of sun-spot maxima this number will be considerably exceeded. Taking the year 1893, which was the most prominent sun-spot year since 1870, I find that on August 7 the value of a was 5128 in the above units. Writing 0·005 for a, the radial solar force is found from the above expression to be $4{\cdot}5 \times 10^{-6}$ C.G.S. On the Greenwich curves such a force would be represented by a displacement of one-tenth of a millimetre.

The magnetic fields on the sun, on which our calculations are based, cannot, of course, form or disappear suddenly, and in view of the smallness of the effect the only question that can arise is whether, if persistent for a sufficiently long time, periodic variations might just be traceable. Some years ago I worked out in full the periodic effects of a magnetised and rotating sun (*Phil. Mag.*, vol. xlvi., p. 305, 1898). The main periods introduced are two, one of twenty-nine days, if the synodic revolution of the sun is twenty-seven days, and one equal in length to the sidereal day. (The period of twenty-seven days drops out altogether.) As regards the former period, it could only show itself if the magnetic state of the sun persisted for a sufficiently long period, and would probably even then escape detection owing to its smallness.

Similarly, the sidereal period would be hidden behind that of equal period and much larger amplitude which is introduced by the seasonal fluctuation of the ordinary diurnal period; but we need not enter into a detailed discussion of the possibility of tracing minute effects. My main object has been to show that the magnetic disturbance hitherto associated with the state of the sun's surface cannot be accounted for by the direct magnetic action of Prof. Hale's electric vortices.

ARTHUR SCHUSTER.

Kew Records of the Italian Earthquake.

THE accompanying traces show records of the Italian earthquake of December 28, 1908, given by the Milne seismograph and the declination magnetograph respectively at Kew. The former shows a very sudden arrival of seismic waves of some magnitude at 4h. 23·6m. a.m. (G.M.T.). If these represent "preliminary tremors" from an earthquake originating in Italy, about 2000 kilometres away, one would expect the large waves not to commence until some seven minutes later. Ordinarily, the maximum amplitude occurs some little time after the large waves commence. In the present case, however, the maximum is shown at either 4h. 31·1m. or 4h. 32·7m., the lateral traces overlapping at both these times. This means a movement of more than 17 mm. at the end of the boom.

It is unusual for the Kew magnetic curves to show any record whatever of earthquakes. On the few past occasions when the magnetic traces have shown anything, it has taken the shape of a burr of vague outline, indicating that the magnets have been put in oscillation. (Ordinary magnetic changes are not discontinuous, and for these the magnets are practically dead-beat.) The present occasion is, I think, unique in that not one, but several, of these burrs are distinctly visible in the original declination curve, though in a copy they will, I fear, be indistinct. The time scale is only 15mm. to the hour, and an uncertainty of at least 0·5 minute must be allowed in estimates of time. To prevent prejudice, the four burrs distinctly seen were measured prior to an inspection of the Milne trace, and the times allotted were respectively 32, 36, 40, and 47

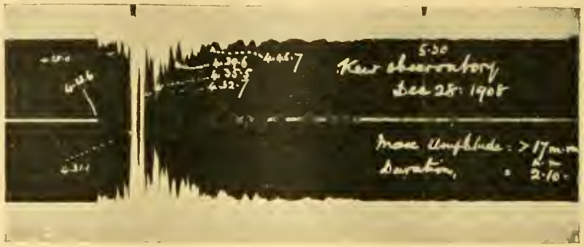


FIG. 1.

minutes after 4 a.m. These answer apparently to the seismic movements of which the measured times are 32·7 (or 31·1?), 35·5, 39·6, and 46·7 minutes after the hour. The original declination trace shows a distinct movement at 4·27, but this is of a different type, and may not be of seismic origin. There is also at 4·23 or 4·24 a very faint suggestion of movement. This may answer to the commencing seismic movement, but, unlike the other movements on the declination trace, it was not noticed until after the Milne record had been examined, and it should be regarded as doubtful.

The horizontal-force curve showed only one conspicuous burr, the measured time for which was 4·33. For some

FIG. 2.

time prior to 4·23 the edge of the declination curve was pretty sharp, and apparently no disturbance existed. Any magnetic effect originating at the seat of the earthquake should have affected the Kew magnets several minutes in advance of the earliest seismic record. Thus in this case, at least, the movements shown on the magnetic curves are of purely mechanical origin—the magnetograph acting as a seismograph—or else they represent some magnetic effect arising in the near neighbourhood on the arrival there of the earthquake waves.

The periods of the declination and horizontal-force magnets and of the Milne boom are respectively about $10\frac{1}{2}$, $13\frac{1}{2}$, and $17\frac{1}{2}$ seconds, and as recorders of earthquakes

none of the three is dead-beat. Thus the apparent amplitudes of the records will depend on the proximity of the natural period to that of the seismic wave. This may account for the fact that whilst the seismograph and the horizontal-force magnet indicate a maximum of disturbance at from 4.31 to 4.33, the declination magnet indicated more disturbance at 4.36. A movement of 17 mm. on the seismic trace answers to a tilt of fully 9″, but it may be produced in a variety of ways, and no immediate deduction is possible as to either the character or the amplitude of the disturbing motion. C. Chree.

January 1.

[Added January 4.—An examination of the glass scale used with the magnetic curves shows that a correction of about −0.5 minute is required to the times deduced by it. This brings the above times from the magnetic and seismic curves into even more perfect agreement.]

The Commercial Products of India.

It is not customary for an author to reply to his reviewers, but I trust you will permit me to depart from that usage. Captain A. T. Gage, superintendent of the Royal Botanic Gardens, Calcutta, stands, to my recent work "The Commercial Products of India," in an entirely different position from an anonymous reviewer, and his opinion, as expressed in certain passages of the notice published in Nature of December 17, 1908, therefore seems to me to call for a reply.

Captain Gage accuses me of having "unnecessarily spun out" certain articles by a "failure to discriminate between essential and superfluous information and between proved facts and mere opinions not worth recording." He then proceeds to exemplify that contention by quoting one sentence regarding tea. Removed from its context, that particular passage might fall under the condemnation he has passed upon it, but when read in connection with the sentences immediately preceding and following, its meaning and value are, I venture to think, abundantly brought out. The contention, it will be seen, is advanced that even in China tea appears to have been first used as a vegetable or medicine, and that it was not until the fourth century that its modern usage as a beverage began to attract attention. If I am justified in assuming that many of my readers may find interesting what had proved such to myself, it seems likely that the fact that the habit of tea drinking is not very ancient, even in China, will not be regarded as superfluous information.

Then, again, Captain Gage apparently objects to my method of exemplifying the failure, so far, with rhea cultivation in Kangra. I have given prominence (so he affirms) to the fascinating effect on myself personally of the undying faith of a very old lady. Now anyone at all familiar with the recurrent interest in rhea and China grass—aware, in fact, of the extent of capital even now at stake—would hesitate to pronounce rhea, as Captain Gage has done, "a distinctly doubtful crop." The fibre, at all events, is in itself immensely valuable, hence, in reviewing India's position in the controversy of future production, I felt myself compelled to give actual results in preference to dogmatic pronouncements. My position regarding India's future participation is briefly that, while we have the "undying faith" of some of the pioneers, the results so far attained have not been exactly favourable; but I have urged that there is distinctly a future for the crop when certain misleading statements and misconceptions have been effectively removed. In other words, I by no means concur with Captain Gage that rhea is "distinctly a doubtful crop."

But my reviewer has fallen foul of me because my abridged articles on tea and rhea (as he thinks) are longer than the originals. Perhaps I may be permitted to explain that the chief difficulty I experienced in writing the work in question was the necessity, imposed on me, to restrict and restrain my efforts on every hand by calculations or ratios of space to articles, and by the final accomplishment of the entire task within one volume. Captain Gage's criticisms on the science of circumscription are, in fact, examples of that very difficulty, only that he fails in the all-important detail of accuracy. If he will consult again the original work he will perhaps discover that it often happened that a subject was there dealt with under two or more positions. In the new work each had to be disposed of once and for all. Hence *Boehmeria nivea*—Rhea—does not have fifteen pages in the old and sixteen pages in the new work, as Captain Gage affirms, but sixty and sixteen pages respectively. So also *Camellia thea*—Tea—does not have fourteen pages in the old and thirty-five pages in the new work, as Captain Gage also affirms, but eighty-two and thirty-five respectively. The articles on these two subjects thus occupy, as near as possible, the exact spaces reserved for them in the scheme of the new publication. George Watt.

Richmond, December 19, 1908.

The Isothermal Layer of the Atmosphere.

I have read with much interest the letters on this subject that appeared in Nature during last February and March, and also the account of the discussion at the British Association (Nature, October 1, 1908), and my only excuse for re-opening the question at this late date is that a point seems to have been overlooked which appears capable of explaining the phenomena without any appeal to an isothermal layer. Both in the correspondence and in the discussion several physicists cast doubt on the accuracy of the thermograms, but, so far as I have seen, only Mr. A. L. Rotch, at the British Association, mentioned that his instruments were verified for low temperatures and pressures. The following physical effect on the barographs does not appear to have been mentioned, and I should be glad to know what precautions are taken to eliminate it in practice. Pressures are necessarily registered by aneroids, and it appears to be assumed throughout all these discussions that a lower pressure on an aneroid means a higher altitude, but this is not so. In 1892, when I was a temporary observer in Ben Nevis Observatory, Mr. Edward Whymper visited the district to have some fourteen or fifteen aneroids of various sizes compared with the mercurial barometers at the low-level station, and as soon as possible afterwards at the top of the hill. It was invariably found that the indexes kept on falling after the aneroids had been brought to rest in the observatory. The rate of fall was at first fast, but became slower as time went on, and it depended upon the difference of pressures between the two stations and also upon the time taken in transit from one to the other, being greater for greater differences of pressure and less for longer times of transit. The aneroid would tend to give the true pressure immediately on arrival or after some hours, according as the standardisation had been rapid or slow. The effect is due to a kind of elastic fatigue, and was reversed on returning the aneroids to sea-level.

Mr. A. Mallock, F.R.S. (Proc. Roy. Soc., vol. lxxx., p. 530), has shown that up to the altitudes corresponding to pressures of about 100 millimetres of mercury the velocity of the balloons increases slightly, but at these altitudes it decreases so suddenly that the hypothetical balloons with which he deals must there have ceased rising. It is clear that at such altitudes the conditions are most favourable to the operation of elastic fatigue. The change of pressure to which the aneroid has been subjected is considerable; the time of ascent is fairly rapid, and the velocity is suddenly destroyed; but although the balloon may cease to rise, the apparent pressure does not cease to fall. Consequently, when the barogram is deciphered, if the effect of elastic fatigue is ignored, an increased height will be inferred at the same epoch as a constant temperature. There may even be an increase of temperature if the balloon should leak slightly or if the gas should be sluggish in acquiring the low temperature of the air into which it has risen, and, cooling somewhat, causes the balloon to descend slightly. It should be remembered that at these altitudes a small change of pressure corresponds to a very considerable change of altitude, so that this effect of fatigue would be greatly exaggerated. The great differences of altitude at which the isothermal layer

has been met would, on the above supposition, receive a simple explanation in the varying mean densities of the balloon and its contained gas on different occasions, since the balloon will come to rest when its mean density is equal to that of the air in which it floats.

In this connection it may not be out of place to recall that an increased velocity of the balloon does not indicate an ascensional current, nor does a decreased velocity indicate a downpour of air. In the latter case, what has more probably happened is that the balloon has crossed a surface of discontinuity in density, and is less buoyant.

J. I. CRAIG.

Survey Department, Giza, Egypt, December 5, 1908.

It does not appear to me that the explanation suggested by Mr. Craig is tenable. I will first state that the instruments used in England are calibrated over the whole range of conditions to which they may be exposed by placing them in a glass vessel so that they are completely covered by liquid which has been cooled to the desired temperature by solid CO_2, and then exhausting the air by a pump. Thus the instrument is exposed at the same time to the conditions of pressure and temperature which it will meet with in use. This is done both before and after each ascent, unless, as sometimes happens, such damage is done by the finder as to render the second calibration impossible. On the Continent, at one station at least, and perhaps at most, the pressure is reduced slowly for the express purpose of meeting the point raised by Mr. Craig. In England, and for the same reason, air is generally left in the aneroid box. Very thin metal is used; the box is dried, the faces are squeezed together so that they nearly touch, and the box is then sealed up. The result is that the pressure scale depends on the elasticity of the enclosed air chiefly, and only slightly on the elasticity of the metal. Of course, there is a large correction for temperature which involves extra trouble in the calibration, but, on the whole, I believe this system to be the more accurate.

The lag of an aneroid box no doubt produces the results described by Mr. Craig, but the error so produced, when expressed as a percentage of the whole deflection of the box, is, I think, small. We have many records in which the isothermal part of the trace covers more than 100 mm. of pressure, and an error of this magnitude could not possibly be produced by the elastic fatigue of the box. Further, in general the balloons burst while they are rising; they start with an ascensional velocity of more than 600 feet per minute, and we have good ground for thinking that the pace is accelerated towards the top. They fall in about half the time they take to rise, and hence, unless there be an isothermal layer, the instrument cannot remain in air at the same temperature for sufficient time for the slow expansion of the box to take place. If further evidence is required it may be given in the fact that the up and down traces show, with hardly an exception, practically identical temperatures, especially in the isothermal region, where, if a lag came into play, they ought to be most divergent.

With regard to ascending and descending currents, we know from our experience with kites that such exist. The pressure of the air must be continuous, but discontinuity in the density may arise from an inversion, the temperature suddenly rising with the height. Five degrees centigrade is a not uncommon amount, but this means a change of density of less than 2 per cent. The free lift of a balloon in these ascents is about equal to the whole weight lifted, and hence a sudden change of $5°$ C. may mean a change of 4 per cent. in the free lift. To meet this the square of the velocity must change by 4 per cent. and the velocity by 2 per cent. This is of quite a different order to the observed variations in the vertical velocity, which in the lower strata may reach 50 or more per cent. It would be of interest to know the rate at which the gas inside approximates to the outside temperature, and the amount of difference which may arise from solar insolation.

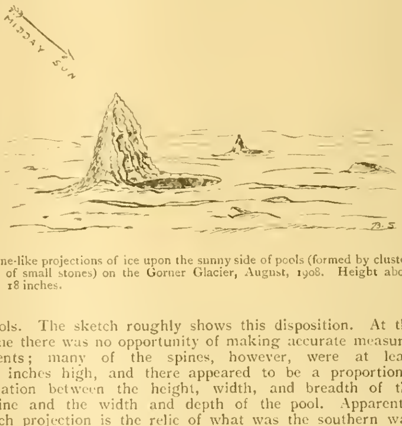
No doubt the point raised by Mr. Craig is an important one, and may lead to serious errors in the height unless especial care is taken to guard against it, but it cannot account for the observed phenomena. In England, at least, we have never claimed great accuracy in the recorded heights, and I do not believe such accuracy to be possible, but our traces show the commencement of the isothermal part at 10 to 12 kilometres, and the balloons often reach 18 kilometres. That elastic fatigue can account for the space between 11 and 18 kilometres is out of the question.

W. H. DINES.

Curious Effect of Surface Ablation of a Glacier.

DURING a traverse of the Gorner Glacier last summer, a peculiar feature in connection with the surface ablation came to my notice which I have never seen described or even referred to. I therefore venture to give a short description of this interesting phenomenon. The surface of the glacier is studded with the usual pools of clear water, due to clusters of small stones which become heated and sink some distance in the ice, the north and south retaining walls of the pool sloping in a northerly direction.

On the southern or sunny side of most of the pools there was a spine-like projection of ice standing vertically from the general surface, and tapering upwards to a jagged knife-edge with an east and west alignment. Upon the northern rather flat (or slightly concave?) sides of these spines there were sometimes vertical ridges, and at irregular intervals the remains of thin, horizontal shelves of ice, which represented former levels of the water in the



Spine-like projections of ice upon the sunny side of pools (formed by clusters of small stones) on the Gorner Glacier, August, 1908. Height about 18 inches.

pools. The sketch roughly shows this disposition. At the time there was no opportunity of making accurate measurements; many of the spines, however, were at least 18 inches high, and there appeared to be a proportional relation between the height, width, and breadth of the spine and the width and depth of the pool. Apparently each projection is the relic of what was the southern wall of the pool when the general surface of the glacier was at a higher level (as shown by the horizontal shelves of ice), and which by some means, perhaps partly because that wall is in shade, has been maintained at a low temperature, and thus enabled to resist the general surface ablation.

BERNARD SMITH.

Blackheath.

Moral Superiority?

Is this worthy of record as exceptional? I fed the birds with soft lumps of bread (not crumbs) this morning; there was a strong frost and 6 inches of snow. The first instant arrivals were two redbreasts and a blue tit. All three flew to the same lump of bread; but the little tit turned with fury on his two (ordinarily) combatant opponents, drove them away, and—while I watched—took his fill of the bread he had won until the usual crowd of sparrows appeared, when he decamped with what was left of his meal, and *then* the redbreasts—as always—ruled the roost.

F. C. CONSTABLE.

Wick Court, near Bristol, December 30, 1908.

SURVEYING FOR ARCHÆOLOGISTS.[1]

VI.—THE FINDING OF DATES.

(1) *By Solstitial Alignments.*

IN the astronomical study of ancient monuments, the archæologist's measures of azimuth and altitude enable him to determine the declination of the celestial bodies the rising and setting places of which are indicated by the direction of avenues or of outstanding stones seen from the centre of a circle.

But this, after all, is but the means to an end; it is only a first step.

The second step is to find, *if possible*, from the declinations, the time at which the sun or a star occupied these declinations. This tells us when the "ancient" stone monument was set out, and because the monument is an ancient one it is certain that the declination of the sun at a solstice and that of the stars were different from what they are now. I will deal with the sun first.

In consequence of causes which need not be gone into here, the angle between the plane of the earth's equator and of the ecliptic—called the obliquity of the ecliptic—is getting smaller. The result is that the sun's declination at a solstice, which defines the value of the obliquity, is less now than it was in times past.

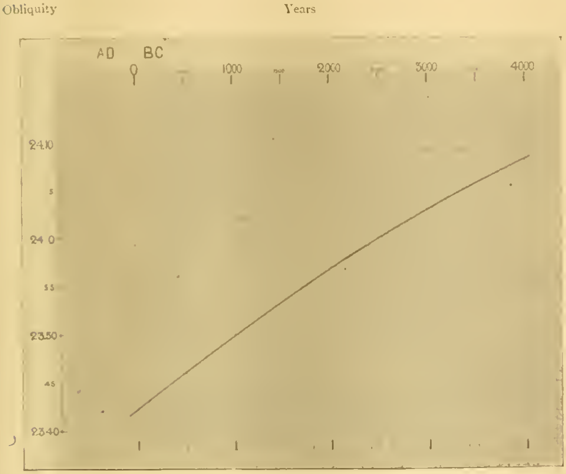


FIG. 25.—Variation of the Obliquity of the Ecliptic, 100 A.D.–4000 B.C. (Stockwell's Values.)

This rate of change is very slow, as will be gathered from the diagram—Fig. 25—a little more than half a degree in 4000 years. The present value is 23° 27′; in 1680 B.C., the date of the erection of the sarsens at Stonehenge, according to the measures made by Mr. Penrose and myself, it was 23° 55′.

Now in these latitudes this change of half a degree in declination produces a greater change in the azimuth. In a previous diagram I have given not only the solstitial azimuth at the present day, in lat. 50° N., but also that of 1680 B.C., showing that there is a difference of nearly one degree; still, this is not certain of detection—considering monument conditions.

Hence, in attempting to deduce a definite date from a solstitial alignment, favourable conditions of the monument, such as the avenue at Stonehenge, and exceedingly careful observations are absolutely essential. Any others are practically valueless, because, as will be gathered from the curve, Fig. 25, an error of only 10′ in the derived declination produces an error of some 1300 years in the date.

It is only the solstitial alignment that can help us, in consequence of the sun then arriving at the extreme declination. An equinoctial alignment is of no use, because with any value of the obliquity the sun's declination at the equinox is always 0°.

From May–November alignments it is impossible to derive any date, owing to the rapidity with which the sun's declination changes at those seasons of the year—more than a quarter of a degree each day.

The only serious attempt so far to derive a date by an alignment to the solstice, using the change in the obliquity of the ecliptic, was made by Mr. Penrose and myself at Stonehenge, but there is little doubt that as our knowledge of the monuments increases other alignments as definite as the avenue at Stonehenge will be found.

The conditions of observation at Stonehenge will be gathered from Fig. 26, in which the line drawn through the centres of the naos, circle and vallum, and passing to the north of the Friar's Heel, represents the common direction of the avenue and of the axis of the temple.

(2) *By Stellar Alignments.*

In previous notes I showed how with certain data, including a measured azimuth and altitude, the declination of the star which rose on the alignment indicated by the monument could be found. Having this declination, the next step is to inquire which star occupied that position in times past, and *when*.

In dealing with stars, the problem of finding a date is much more within the possibility of observation than in the case of the sun. The stars change their declination 47° in 25,800 years, that is, 1° in 550 years on the average, and some stars at some times change it much more rapidly.

This relatively very great change in the declination of stars from century to century is brought about by the action of the sun and moon.

The action referred to does not depend upon the actual attractions of the sun and moon upon the earth as a whole, which are in the proportion of 120 to 1, but upon the difference of the attraction of each upon the earth's bulge at the equator, arising from the fact that the equatorial diameter is the larger. As the sun's distance is so great compared with the diameter of the earth, the differential effect of the sun's action is small; but, as the moon is so near, it is so considerable that her precessional action is three times that of the sun.

An important result of the action on the protuberance has now to be considered. The change in the position of the equator—caused by the attraction—is brought about by a rolling motion, which is necessarily accompanied by a change in the earth's axis.

In Fig. 27, *ab* represents the plane of the ecliptic, CQ a line perpendicular to it, *hfe* the position of the equator at any time at which it intersects the plane of the ecliptic in *e*. The position of the earth's axis is in the direction C*p*. When, by virtue of the precessional movement, the equator has taken up the

[1] Continued from vol. lxxviii., p. 574.

position lkg, crossing the plane of the ecliptic in g, the earth's axis will occupy the position Cp'.

The lines Cp and Cp' have both the same inclination to CQ. It follows, therefore, that the motion of the earth's axis due to precession consists in a slow revolution round the axis of the celestial sphere, perpendicular to the plane of the ecliptic. During this movement, while the inclination of the two planes remains nearly $23\frac{1}{2}°$, the position of the celestial pole, and consequently our pole star, are constantly changing.

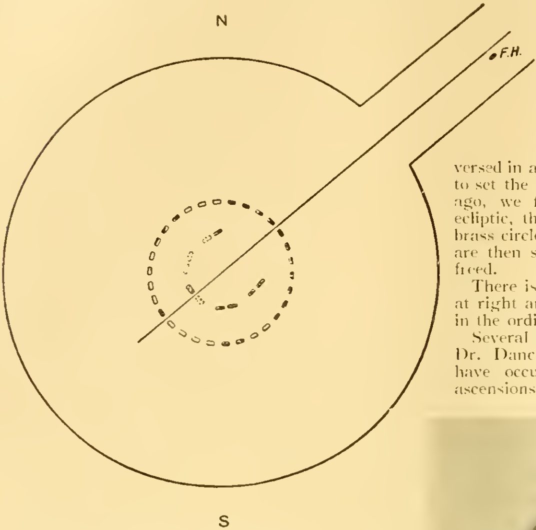


FIG. 26.—General Plan of Stonehenge; the outer circle, naos and avenue; F.H. = Friar's Heel.

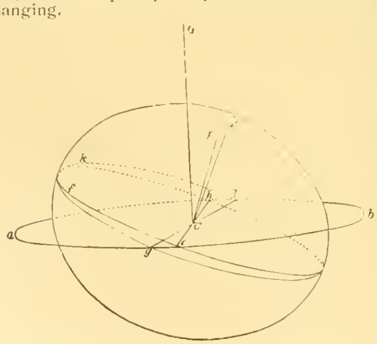


FIG. 27.—Showing the effects of precession on the position of the earth's axis.

An ordinary celestial globe represents the right ascensions and declinations of stars at some epoch near our own time, but some years ago I devised a globe in which the changes brought about by this precessional movement can be shown in a very concrete manner, so that the changes in position can be readily understood.

The precessional globe, as I called it, is, in fact, arranged so that the position of the celestial pole and equator, and consequently the positions of the stars, may be represented at any epoch. In the globe pivots are provided so that it may be turned on the pole of the ecliptic; round these at a radius of $23\frac{1}{2}°$ are brass circles (one of which is shown), with holes in them, each of which may also be used as a pivot. One pair of pivots on the latter circles corresponds to the present celestial poles, and represents the heavens as they are at the present time; the globe is arranged to turn on these, the ecliptic pivots being thrown out of gear. Other pivots on the brass circles correspond to other dates, the whole circle being traversed in about 25,800 years. For example, if we wish to set the globe to represent the conditions 2000 years ago, we first swing the globe on the poles of the ecliptic, then turn it until the desired points on the brass circle are brought under the other pivots. These are then screwed into position, and the first two are freed.

There is a brass meridian, passing round the globe at right angles to the horizon, which is graduated as in the ordinary celestial globe.

Several astronomers, including the late Mr. Hind, Dr. Danckworth, Dr. Lockyer, and Mr. Stockwell, have occupied themselves in calculating the right ascensions and declinations occupied by stars in past

FIG. 28.—The Precessional Globe. A, Pole of ecliptic; B, brass circle, with holes on positions of celestial poles at different epochs; C, screw pivot for N. pole of ecliptic; D, screw pivot for N. celestial pole at different epochs; E, scale of years denoting position of celestial pole at definite epochs (set for 1364 B.C.); F–G, brass meridian; H, H, H, H, wooden horizon; J, ecliptic; K, celestial equators drawn for different epochs.

times. Curves given in "Stonehenge" (pp. 116–117) show the changing declination of the brightest stars—and this is the component of greatest importance to the archæologist—from 250 A.D. to 2150 B.C.

A glance at the curves will show that the same declination is occupied by different stars at different dates; hence it may happen that the declination found fits more than one star within probable date limits, and so we have to decide which is the more likely star to have been observed. It might at first sight seem that it would be difficult to settle which star is really in question. But in practice the difficulty does not often arise. We now know that the stars used were those in high northern or southern declinations for noting the time at night in the way the Egyptian temples have familiarised us with, and stars nearer the equator to serve as "morning stars," warners of sunrise.

The stars with about the dates already revealed by the work of the last few years may certainly be considered in the first instance.

It is really not a remarkable fact that so few stars are in question, for the use made of them was very definite. Capella, Arcturus, α Capricorni, Pleiades, and Antares almost exhaust the list.

The use of the precessional globe saves many intricate and laborious calculations when only an approximation is required. Thus warning stars at any quarter of the May or solstitial year at any given date may be found by rectifying the globe for the latitude of the place of observation, marking the equator at that date by a circle of water-colour paint by holding a camel's-hair pencil at the east point of the wooden horizon, and rotating the globe. The intersection of the equator and the ecliptic gives us the equinoxes at that date, their greatest separation the solstices. With these data we can mark the required position of the sun on the ecliptic.

This done, if we rotate the globe so as to bring the sun's place 10° below the upper surface of the wooden horizon, the star the rising of which can be used as a warner will be seen on the horizon.

Nor does the use of the globe end here. With a given azimuth, which are all marked on the wooden horizon, the globe may be adjusted to different dates and then rotated until at a certain date a star rises at that azimuth.

NORMAN LOCKYER.

GEODETIC SURVEYS.

THE latest volume (vol. xviii.) of the Great Trigonometrical Survey of India contains the records of astronomical observations for latitude extending over the last twenty years. It is, in effect, the continuation of vol. xi., and brings this particular department of Indian Survey statistics up to date. It consists chiefly of tabulated records; 543 pages alone in part ii. being absorbed by tables of astronomical latitudes. There is therefore nothing to offer in the way of remark or criticism on the great bulk of detail contained in this volume except congratulation on the completion of a work involving so much labour in compilation. It is, perhaps, the most interesting of the whole series of Great Trigonometrical Survey records and the interest of it to the general reader lies in the preface, where Colonel Burrard, in plain and simple language, gives the reasons for the faith that is in him as regards the present position of geodetic work in India.

To those who have pinned their faith to the rigid accuracy of geodetic triangulation as the basis of fixed points for the further extension of minor systems of triangulation and of topographical survey, it may at first sight appear somewhat disturbing to be assured that there is no finality in sight for the value of any fixed point in India, either in latitude, longitude or altitude. Geodetic science can only develop on a system of trial and error. Only by the most rigidly exact systems of measurement possible to human agency can the shape of the earth's figure be precisely determined, and only, when the precise shape of that figure has been determined, can geodetic calculations be satisfactorily computed. Hitherto these calculations in India have been based on an assumed earth-figure known as Everest's spheroid, and although this assumption is not absolutely justified by continuous observation, Col. Burrard rightly maintains that it would be a mistake to break the continuity (and thereby destroy much of the value) of the Great Trigonometrical Survey series by the introduction of tables based on new, and possibly only half-digested, data. Similarly he pleads for absolute accuracy in the determination of latitudes, for it is only when the riddle of the earth's shape shall be solved by the men of science of the future, and the pathway to positive deductions therefrom straightened out, that the full value of this most remarkable body of results (obtained by new and more perfect instruments from observations of stars of which the position is now more certainly known than heretofore) can be effectively utilised

The deflection of the plumb-line forms one of the principal subjects of scientific investigation of which the record is to be found in this book. This deflection is determined by the difference in latitude obtained for any fixed point between the results of geodetic triangulation and of astronomical observation. For reasons already suggested in connection with the assumption of the earth's figure, as well as the fact that the origin of geodetic latitudes in India (at the Kalianpur base) is itself an assumption, there still remains an element of uncertainty in these determinations. They are exceedingly interesting. "In the Himalayas" (which is, perhaps, a slightly vague definition) the deflection amounts to −35·29s.; at the foot of the Himalayas it is −10·90s.; in central India it amounts to +0·94s. But it must be remembered that in dealing with this matter of rigid accuracy we have still to reckon with minutely small errors, quantities that are immaterial for the practical purpose of supplying a basis for map-making. For instance, the most improved methods of observing with the best of new instruments only displaces the assumed value of the Kalianpur latitude by 0·3″. In the matter of longitude there is, however, a recognised error of 2′ 27″, which is an error too large to be neglected. This has to be eliminated from Indian mapping; although, again, Col. Burrard deprecates any interference with the continuity of Great Trigonometrical Survey records in the series ended by this eighteenth volume. To this extent Indian topography and Indian geodesy must remain discrepant for a space of time.

There is, however, one element of disruption in Indian Geodetic Survey work with which no man of science can deal. This is caused by earthquakes, and the resulting displacement of mark-stones is not easily determined. There may be little relative displacement over a large area, whilst the absolute displacement of the whole area may be considerable. It is impossible to re-triangulate the vast spaces which would be necessary to determine this, nor does it appear to be at all easy to discover what may be the effect of such disturbances in altitude. The most careful levelling (three times repeated) over the eighteen miles separating Dehra from Mussoorie only revealed a probable diminution of 5½ inches in the Himalayan altitudes at Mussoorie after the latest, and most violent, earthquake. Meanwhile geodetic science fulfils its mission admirably in the great practical work of establishing the basis for topographical surveys. These never can be affected by those small geodetic adjustments which are all-important to the scientific theorist, although it

is quite possible that such displacements as are caused by earthquakes might be troublesome to the map-maker. Topography, however, can never be final; never (under some conditions) complete. Col. Burrard, in his admirable preface, aptly quotes the shifting Indus as a case in point. Could the whole Indus valley be surveyed in any one year we could then say "that was the course of the Indus in the year ——." As it is we can never hope to possess an accurate topographical representation of the Indus from the mountains to the sea at any one time—nor does it much matter if we cannot.

The expense and the labour of geodetic triangulation undoubtedly imposes certain limitations on its practical use, and probably no record in scientific history of its misapplication is more remarkable than that which may be found in the Government report on the Boundary Survey between British Bechuanaland and German South-west Africa. Here an elaborate series was extended at a ridiculous cost, and involving the labour of several years, in order to determine the position of a meridian line (running through the Kalahari desert) which had been defined by diplomats in England as the only possible boundary. The possibility of the existence of gold or diamond mines demanded an exact and visible demarcation no doubt; but where that demarcation was carried through the undeveloped and waterless wilderness was not a matter of significance, provided it were somewhere near the defined line. It may be that the meridian (almost the worst boundary definition possible) was without an alternative, in which case a most important word must have been inadvertently omitted from the protocol, or agreement. That word was "approximate." A free use of it in the original definition, and a liberal interpretation of it in the field, would have enabled a topographer to run a plane-table traverse quite sufficiently close to the meridian on a "chronometric" longitude to have fixed up the boundary marks as he proceeded, and so to have completed the whole boundary in, say, one-fifth the time and at one-tenth the expense of the geodetic determination. It is not as if this geodetic determination resulted in rigid (and unnecessary) accuracy. Col. Burrard's preface to his eighteenth volume at once disposes of any such possible pretension; nor is it as if it formed the basis for useful topography, for not a square mile of topography resulted. The only result is a possibly useful basis for the extension of future triangulation in German territory—and for this the German Government should have paid.

T. H. H.

THE RÔLE OF LIQUID CRYSTALS IN NATURE.

THIRTY-SIX years have elapsed since Prof. Otto Lehmann, while a student at Stuttgart, designed a novel form of microscope which permitted of the optical examination of substances at temperatures differing considerably from that of the surrounding air, and thus obtained access to an almost virgin field for research, to the cultivation of which he has strenuously devoted himself. The results of a long series of observations were collected and published in the form of the fine volume entitled "Flüssige Krystalle," which was noticed in NATURE in 1904 (vol. lxx., p. 622). Prof. Lehmann, however, by no means intended that work to constitute his last word on the subject, and, as is testified by the numerous papers which have since that date appeared from his pen in various journals, he has in no way relaxed his efforts in the prosecution of his investigations. Of recent years, moreover, other workers have in greater number been attracted to the subject, and their observations are, on the whole, in harmony with his, and confirm the substantial correctness of the views he has put forward. In particular, mention may be made of Prof. D. Vorländer's extensive investigations of the azoxy-compounds. Although there was in early days, not unnaturally, considerable scepticism regarding the correctness of Prof. Lehmann's observations and the deductions he made from them, there is at the present time little reason to doubt the reality of the existence of anisotropic liquids and the importance of the *rôle* they play.

At first sight it may seem ridiculous and absurd to suppose that any immediate relation can subsist between the properties of liquids and crystallised matter. The study of the characters of crystals has demonstrated that the molecules composing a crystal are regularly arranged at the nodes of the corresponding space-lattice. Such a structure possesses great rigidity, a character incompatible with the mobility of a liquid. It is, indeed, very probable, as Mr. William Barlow suggests, that the spheres of influence of the constituent atoms are all in contact with their immediate neighbours, and the molecule has no separate entity in the crystal. On the other hand, in a gas the molecules have clearly a distinct existence; they are in constant motion, and for the greater part of their course are remote from one another, and, if not kept within bounds in some way, would altogether part company. It is not difficult to suppose that a liquid may be a compromise between such different states; it may retain, though to a lesser degree, both the regularity of the solid and the mobility of the gas. That extreme rigidity is not an essential property of a crystalline structure is evinced by certain minerals—mica being a conspicuous example—which are susceptible of considerable bending without permanent derangement of the structure. Solid substances break when the limit of elasticity is reached, or, in other words, when no further slipping of the spheres of influence upon one another is possible without a collapse of the equilibrium. There are, however, substances with small rigidity in which a greater amount of shear is possible; to these viscous substances, of which the melted modification of silver iodide is a familiar instance, Prof. Lehmann applied the term "fliessende Krystalle." Finally there are substances with almost negligible rigidity in which so much relative slipping is possible without a collapse that, though anisotropic, they are as mobile as water; these he has called "flüssige Krystalle."

No sharp distinction can, however, be drawn between the three groups. Indeed, one curious substance, the ethyl *para*-azoxycinnamate, has been discovered which is solid in the direction of the principal axis, but fluid at right angles thereto. Further, some substances, such as cholesterylcaprinate, have two liquid modifications. Certain of them—*para*-azoxyanisol, for instance—become turbid on melting, but on increased heating suddenly clarify at a definite temperature. The turbid liquid was at first supposed by many physicists to be an emulsion; but recent investigations by Dr. R. Schenk and Dr. A. C. de Kock indicate that the turbid liquid is a homogeneous phase. The mutually repulsive action—possibly an electromagnetic phenomenon—that characterises the molecules of a gas takes in a liquid the form of an "expansion-force," as it is termed by Prof. Lehmann. This force varies in different directions according to the symmetry of the molecule, and consequently the envelope of the liquid crystal, as seen in the microscope, is polyhedral, the corners being rounded owing to the effect of surface-tension. The contour is circular when the expansion-force is nearly

uniform in all directions, or is small compared with the surface-tension. This tension is merely a convenient way of expressing the resultant effect of the mutual attractions between the molecules upon the envelope. The curious myelin forms developed when certain fatty substances are dissolved in water are an interesting illustration of this phenomenon. It has recently been discovered that, while the interior is isotropic, the envelope is liquid-crystalline, and that the typical marrow-like shape results from the preponderance of the latter; the contour is circular when the envelope is thin. It was with some hesitation that Prof. Lehmann proposed the extended signification of the word crystal; it is, however, difficult to suggest an alternative, and, etymologically at least, a good claim may be made out for its use to denote the fluid form.

That crystals, when placed in the saturated mother liquor, grow and have the power of healing fractures are characteristics so similar to the attributes of certain of the lower organisms that they suggest the possibility of crystallised matter being a form of life; but a little consideration raises insuperable objections to such a theory. Prof. Lehmann's researches, however, throw fresh light upon the problem, and he ventures with some confidence to assert, not that crystals themselves are living, but that crystallisation is the agency made use of by living growth. A glass or jelly, or any other amorphous substance, does not grow; on cooling it passes gradually from the melted to the solid condition, and forms about a large number of nuclei, just as happens in the condensation of vapour. Crystallisation is a very different phenomenon; the growth is rapid and the nuclei are comparatively few. The distinction consists in the want of homogeneity of an amorphous substance, which results in the neutralisation of the intermolecular action. In such a substance doubtless several arrangements of the constituent parts are possible for equilibrium, and though there may be uniformity over a not inconsiderable region—judged by molecular dimensions—the resultant effect is chaos. Prof. Lehmann noticed further that liquid crystals, when under the influence of a magnetic field, coalesce and range themselves with their axes in the direction of the lines of force; in other words, the growth of an individual takes place. In fact, the similarity in aspect and behaviour between certain liquid crystals and bacteria is remarkable, and can scarcely be accidental. Prof. Lehmann suggests that in life the directional force is that mysterious essence so much discussed and so little understood—the soul. In support of this bold hypothesis he puts forward many cogent arguments and marshals an array of facts, but much work and consideration are necessary before it can be accepted with any confidence. Nevertheless, it must be admitted that Prof. Lehmann has made an important contribution to the solution of the great question confronting alike science and philosophy—what is life?

G. F. H. S.

METEOROLOGICAL REPORTS BY WIRELESS TELEGRAPHY.

THE British Meteorological Office is making arrangements in conjunction with the Deutsche Seewarte, Hamburg, for an experiment in the transmission of meteorological reports by wireless telegraphy. The intention is to make an experiment extending over a period of three months. It was anticipated that arrangements would be concluded in time for commencement with the New Year. It has been found necessary, however, to postpone the actual experiment until February. In the meantime the preparations for the transmission to the Meteorological Office of reports from the ships of the Allan, American, Anchor, Atlantic Transport, Canadian Pacific, Cunard, Dominion, Red Star, and White Star lines have been completed, so far as they can be without trial, and the agents of the Marconi Company in London have already notified their officials to proceed from January 1.

There are many points as to instruments and other matters likely to arise which can only be solved by experience, and the position for effective cooperation will be improved by a trial of the arrangements in view. With this object, instructions as to observations and forwarding the information have been sent to the lines which are so courteously aiding this experiment, and full advantage is being taken to secure observations at once, and to avoid the loss of information for so important a month as January. Wireless telegrams from ships in different parts of the Atlantic may be expected now at any time. The disturbances which exert such an important influence on our weather, especially in the winter, arrive almost without exception from the Atlantic, and it is believed that observations showing the movements of these disturbances will materially add to our knowledge of the weather changes, and aid in weather forecasting.

THE ITALIAN EARTHQUAKE.

NEVER had earthquake taken such toll of human life as that which has just devastated Calabria. Hundreds had been killed by a single earthquake, or thousands, exceptionally the number had run to tens of thousands, but the Yeddo—now Tokio—earthquake of 1703, with its death-roll of 200,000, had stood in a class by itself; yet even this great number seems insufficient to count the deaths on the morning of December 28, 1908, and if to those whose lives were ended by the immediate effects of the earthquake we add the subsequent deaths from injury, exposure, and sickness, the loss will amount to well over a quarter of a million lives.

In face of such a disaster humanity, staggered at first, has thought of nothing but relief or palliation, and the daily newspapers, filled with accounts of destruction, misery and rescue, have contained little information from which we can form a proper judgment of the nature of the shock or its magnitude. This much, however, is clear, that the earthquake was of the first order, not so great, perhaps, as the Californian or Chilian earthquakes of 1906, but far greater than the Calabrian ones of 1905 and 1907, and as great as either of the celebrated earthquakes in 1783, which caused 40,000 deaths in the same districts as have just suffered an even greater loss of life.

From Pizzo the band of destruction extends southwards for about 50 miles through ill-starred Monteleone, which no earthquake seems to spare, Palmi, and Bagnara, to Reggio di Calabria. In Sicily Messina has been destroyed, and Gazzi, but except from this narrow strip of country we have few reports. Catanzaro suffered, to what extent does not appear, and at Cosenza the damage was great; in Sicily houses were destroyed in San Filippo, near Milazzo, and many were damaged in Caltanisetta and Noto, yet Catania escaped uninjured, and at Taormina only one building is said to have suffered any injury. The shock was felt, though slight, at Brindisi and Taranto, at Naples and Castellamare, and at Palermo the population fled in terror into the streets, though no damage was done.

From the interior of Aspromonte no news has come as yet, but the scanty information, summarised above, is enough to show that this earthquake, like most of those in Calabria and Sicily, was polycentric, originat-

ing, not from a single focus or centrum, but from a number of centres of greater intensity, the greatest of which lay close to the coast and for the most part beneath the sea. Moreover, it was no mere earth*quake*, but one of those great disturbances by which the whole world is shaken, which penetrate deep into its substance, and result in a permanent alteration of its shape. This would be sufficiently proved by the great sea wave which washed the shores of the Straits of Messina and the Tyrrhenian Sea, which swept over Messina and Reggio with a height of 30 feet, which caused three deaths at Catania and reached at least as far as Malta. This wave could only have originated in a great displacement of the bed of the sea, the nature of which is indicated by the narrative of the captain of the *Hopewell;* according to him, the boat, which was passing through the Straits at the time of the earthquake, seemed to leap into the air, as if a mine had exploded underneath her, and immediately afterwards a mountain of water was heaped up to starboard and rushed furiously towards Messina, while soundings showed that the bed of the sea had risen ten feet. This last statement requires confirmation, and only careful and extended surveys can define the extent and nature of the displacements which have taken place; but, even without these details, the breakage of all submarine cables, no less than the sea wave, show that the earthquake must have been accompanied by the production, under the sea, of a "fault" or dislocation of the surface, such as is not an infrequent accompaniment of very great earthquakes.

The most interesting and important question raised by this earthquake and its predecessors of 1905 and 1907 is whether the region may now look for respite or whether it is becoming unfit for human habitation, a question the answer of which requires a consideration of what is known of the cause of earthquakes and the past history of Calabria. Whatever may be the ultimate cause of an earthquake, there seems little room for doubt that it is of the nature of a gradually increasing strain, leading, in the end, to sudden rupture and the setting free of forces of which we still know little. Sometimes this strain will grow until the relief comes in a single great earthquake, with nothing visible or noticeable as a preparation or warning; in other cases we have had what, after the event, have been recognised as preparatory shocks. As an instance may be taken the Japanese earthquake of 1891, which gave rise to displacements along a fault-line 65 miles in length, and was preceded by minor earthquakes at either end of the line of this fault; it has been suggested, and the suggestion is plausible, that these gave partial relief to the growing strain, but that the ultimate effect of this partial relief was to equalise the strain along the line of the fault until finally no partial relief was any longer sufficient, and a general yielding resulted in the Mino Owari earthquake and fault.

Similarly, the shocks of 1905 and 1907 might be regarded as preparatory to the greater earthquake of 1908, and the supposition gains weight from the fact that they affected respectively the northern and the southern portions of the area in which the recent earthquake took its origin; but this interpretation suffers from the absence of any certain test by which we may know the preparatory shocks from the earthquake of which it is the forerunner, and be certain that the last of the trio is not itself preparatory to a still greater shock. Some light seems to be thrown on this question by the earthquakes of 1783; on February 5 of that year a severe and destructive earthquake ravaged much the same region as the shock of 1905; it was followed next day by an even greater earthquake, which, like the last, destroyed Messina, and was accompanied by a great sea wave; other lesser but still destructive shocks took place on February 7 and March 28. It will be seen from this that the events of the three days of 1783 were not unlike those of the three years of 1905–8, and the analogy bears closer examination, so we may conclude that, as the great cataclysm of 1783 was followed by a sixty years' respite from destructive earthquakes, and the lesser one of 1638 by a twenty-one years' respite, so the disaster of 1908, though it will be followed by a series of aftershocks, some of which probably will be severe, may reasonably be expected to inaugurate a long era of comparative repose during which the population will have time to recover. But so long as it consents, or prefers, to huddle together in towns and villages which, however gratifying to the artist's eye, are villainously built, and designed in defiance of every precaution which should be taken in an earthquake-shaken country, so long will every earthquake of any degree of severity result in loss of property and of human life.

R. D. O.

Few precise particulars as to the physical characteristics and effects of the Italian earthquake have appeared in the daily papers. We are glad to notice that Prof. Ricco, director of the observatory at Catania, has been instructed by the Italian Government to study the causes and effects of the disaster. The following extracts, chiefly from reports in the *Times*, have been selected from a mass of descriptive material relating to the earthquake.

SEA WAVE.

An officer of the Italian torpedo-boat *Saffo*, carrying bread to Messina, has given the following account of the catastrophe:—

"At 5.20 a.m. we noticed the sea suddenly rising until it attained an enormous height, giving a violent shock to ourselves and all the shipping anchored in port, finally hurling itself with a deep rolling noise towards the quay, overturning a bridge and smashing to pieces most of the ships.

"A moment afterwards the surface of the sea appeared covered with wreckage and cargo, cases of paraffin oil, and boxes of fruit. An exceedingly dense cloud covered the city.

"Only at dawn was it possible to form an idea of the disaster. Almost the whole city was reduced to a heap of ruins. In the midst of all this ruin were still standing the walls of the Town Hall and the Trinacria Hotel. The streets were completely obstructed in several parts of the city, which were now reduced to ruins. Red flames arose, accompanied by huge columns of smoke."

The captain of the Russian cruiser *Admiral Makaroff* states that the great shock lasted 37 seconds, and was followed by four huge waves, while minor shocks continued to be felt during the whole time that his crew were engaged in the work of rescue.

The sea wave which followed the earthquake invaded Reggio so far as the Corso Garibaldi, namely, more than 10 metres above sea-level. The houses near the sea were flooded up to the first storey, and several were washed away by the waves. Twenty-nine miles of railway have been destroyed, and all the stations near Reggio are in ruins.

A man who was just embarking on a ferry-boat to go from Messina to Reggio when the shock occurred describes how the level of the water seemed suddenly to descend until the ferry touched bottom, and then rose to a great height again—he says eight yards—hurling the ferry-boat on the landing pier, which smashed it to pieces.

METEOROLOGICAL CONDITIONS.

On Sunday, December 27, heavy rain fell in the afflicted district, the downpour during the night being torrential. At about 5.15 a.m. on December 28 three distinct and long earthquake shocks are said to have been felt at Messina. Only a little rain fell on that day, but there

was heavy rain at night and all Tuesday, when there was also a high wind.

Almost immediately after the earthquake the very cold weather in northern Russia suddenly changed, and the weather resumed its normal state.

Affected Area.

The sea-wall in front of the city of Messina has been broken up and has fallen, and the sea-walk has sunk under the water. Prof. A. Ricco, the director of the observatory at Catania, states that the docks and other harbour works at Messina have sunk to the level of the water.

At Reggio the destruction seems to be even more complete than at Messina, for the whole of the city has been razed to the ground. The greater part of the sea front is under water. The whole area of the ground below Reggio seemed to have turned over, and a great part of the city is in ruins, covered by the sea. In many places deep chasms appeared in the streets. Of all the villages looking towards Reggio on the coast, not one has been left standing.

The Prefect of Reggin states that the centre of the town has settled down to the sea-level, and only the small villas on the promenade between Reggio and Campi, situated on the highest point of the town, remain standing. The sea front has been swept away, while the water in shore is blocked with sunken débris. Access by sea is impossible, and the town cannot be approached by land, as for a radius of eleven miles the country has a torn and twisted appearance, roads, bridges, footpaths, and railway lines being uprooted. The face of the country has changed, and big fissures in the land have appeared.

The greatest damage was done in the low-lying and unfortunately most important portions, but both at Reggio and Messina this seems to have been due to the actual shock of the earthquake. The subsequent wave flooding the lower houses is said to have risen gently, and does not appear to have added much to the total damage.

In Reggio all the new houses of not more than 32 feet in height have resisted the shock completely. The houses along the Via Marina and the Corso Garibaldi on the sea front fell down to the first floor. Many of the old houses lost their walls on the side which faced the sea to the north. The new dwellings erected at Ferruzzano by the Milan Committee after 1905 have suffered no damage, though they were severely shaken; this is attributed more to the fact of their limited height than to their special construction.

The Admiral-Superintendent of Malta Dockyard has requested the Collector of Customs to make it known that the statement that the Straits of Messina are unrecognisable is incorrect. The topography of the Straits is said by him to be unaltered.

A message from Rome on December 30 states that the submarine cable with the Ionian Isles is broken, and it is feared that the earthquake may have caused damage in the group.

The commander of a torpedo-boat, which was sent to inspect the Lipari Islands, has informed the Ministry of Marine that the shock of December 28 was very severe, and that several buildings were cracked, but that no one was killed.

Prof. Ricco informed a correspondent of the *Daily Mail* that the earthquake had its maximum violence in Sicily and at the southern point of Calabria. The ruin spread from Castroreale, in Sicily, to Palmi, in Calabria, or a distance of forty miles. Damage to buildings occurred from Riposto and Patti, in Sicily, to Pizzo, in Calabria, a distance of eighty-six miles. The earthquake was felt violently from Mistretta and Noto (Sicily) to Cosenza (Calabria), a distance of 186 miles. It was felt, though only slightly, at Marsala and Trapani (Sicily), and even in Naples.

Taormina has escaped unscathed, except that the hotel San Domenico, occupying the site of the old Dominican monastery, has been somewhat damaged.

Seismographic Records.

The seismographic instruments at Laibach Observatory registered the earthquake at 5.22 and 6 a.m. Of twelve instruments, only one was able completely to register the successive shocks, as the oscillations were more violent than the instruments could measure. The maximum oscillation was registered at 5h. 26m. 16s. The seismic commotion noted at Ekaterinburg, and other observations, indicate that the wave of the disturbance moved south-west to north-east Europe.

The seismograph at Perth Observatory, Western Australia, recorded the earthquake, showing vibrations apparently at two periods of maximum intensity.

Subsequent Disturbances.

A slight further shock was felt at Palermo on December 30. There was a more violent shock at San Marco Argentino during the night of December 29, accompanied by prolonged subterranean noise. Many houses were damaged, among them the church and the public buildings.

Shocks, less severe but always accompanied by subterranean rumbling, were felt in many places in Calabria during December 31.

Two earthquake shocks were felt at Algiers at about 6.30 p.m. on January 1. The shocks lasted about three minutes, and damaged some telephone wires.

Etna, Stromboli, and Vulcano were quiescent before and throughout the earthquake disturbance. On January 3, however, at 5.22 a.m., a violent shock of earthquake lasting three seconds was felt in the island of Stromboli. It was accompanied by an eruption of the volcano and prolonged subterranean rumblings. Buildings were seriously damaged, many houses being rendered uninhabitable.

At 11.44 p.m. on January 4 a shock of earthquake was felt at Tenerife, lasting twelve seconds. Bells were rung in the houses, and furniture was overthrown.

Summary of Phenomena.

The Rome correspondent of the *Times* gives the following details of the earthquake in telegrams on January 2 and 4:—Among the phenomena which accompanied the movement the most notable is the wave which swept both shores of the Straits. The accounts as to the height to which the sea rose vary enormously. At Riposto, on the Sicilian coast, it was said to be 10 metres high. That seems to be an exaggerated estimate, and no doubt more exact knowledge will be soon forthcoming. All the survivors speak of the subterranean rumbling sound, which they generally describe as a dull roar that seemed beneath and around them, simultaneous with the first shock, and lasting during the subsequent shocks. Of the number, frequency, and violence of the subsequent shocks there are again very varying accounts. The apparatus in the Observatory of Mileto, Calabria, had registered twenty-eight shocks before it was destroyed. Vast fissures in the ground are reported at both Reggio and Messina. At Messina some eye-witnesses declared that the ground seemed to throw out stones, which were hurled to a considerable distance. The weather conditions of those days have their significance. There was a marked depression in the extreme south of Italy two days before. On both December 27 and 28 it rained, and on the night of December 27 it rained in torrents. Rain fell again at intervals throughout Monday and Tuesday (December 28 and 29), and on the latter day it was accompanied by a violent wind.

Prof. G. B. Rizzo, who fortunately escaped from his fallen observatory at Messina, states that the action of the sea wave has been much exaggerated. In his opinion, the shock on the Sicilian side of the Straits caused a movement of water against the Calabrian side, followed by a re-flow against the Sicilian side and Messina, naturally with less violence. Very little loss, he thinks, was caused by the wave at Messina, where the sea hardly advanced ten yards beyond the sea-wall. What is really remarkable, and should be the object of careful study, is the raising of the level of the seashore; Prof. Rizzo noticed that several boats anchored some distance from shore were left high and dry. On the other hand, the ground has sunk in some places in the city, notably near the Municipal Palace and Via Seminario, where in one place it has fallen eleven yards.

DR. GEORGE GORE, F.R.S.

DR. GEORGE GORE, F.R.S., whose death was announced last week, was born at Bristol in 1826, the son of a small cooper. First as errand-boy and afterwards as cooper's apprentice, he devoted himself to whatever scientific studies came within his reach.

He went to Birmingham in 1851, and made his home there for the remainder of his life. His occupations were numerous and varied; at one time he was a practitioner in medical galvanism, at another chemical expert in a phosphorus factory, and again a lecturer in physics and chemistry at King Edward's School. He always, however, employed himself in original investigation, more especially in the province of electro-metallurgy, whenever his other work would allow, and his knowledge of electrochemical processes enabled him to be of the greatest service to the electroplating industry in the town of his adoption.

His researches on hydrofluoric acid and the fluorides, definitely proving the analogy of these compounds with those of chlorine, are well known to chemists, and in 1865 he was elected to the Fellowship of the Royal Society in recognition of the value of his work. It may be noted in this connection that many years later he was only just anticipated by Moissan in the isolation of fluorine.

In 1877 the honorary degree of LL.D. was conferred on him by the University of Edinburgh as an acknowledgment of his services to science. Some years later he declined the offer of a knighthood, but in 1891 he accepted a Civil List pension.

From the age of thirteen he had had to rely upon himself for his own education, which occupied all his spare time at a period when he was earning his living by arduous labour. Hence it is not surprising to find that one of his characteristics was an extraordinary degree of energy, which, making him one of the greatest of workers, enabled him to accomplish very much, even for a lifetime of close upon eighty-three years. His was a restless mind, constantly seizing upon fresh subjects for research, and the result of this may be seen in the length of the list of publications associated with his name in the Royal Society's catalogue. It may be, indeed, that this very quality, by distributing his energies, was an obstacle to achievements of still greater importance which might have ensued upon the concentration of an intellect combining so much ingenuity and so great a capacity for work.

He was strongly impressed with the necessity for State endowment of scientific research, and was partly instrumental in procuring for the Royal Society the Government grant of 4000*l*. a year for this purpose.

In addition to his contributions to learned societies, he published a text-book on "The Art of Electrometallurgy," and a volume on "The Electrolytic Separation of Metals"; he also wrote a treatise on "The Art of Scientific Discovery." His mind always had a bent for philosophy, which expressed itself more especially in his later years. He was an unswerving materialist, and his views may be gathered from his recently published work on "The Scientific Basis of Morality."

G. A. S.

PROF. J. M. PERNTER.

AS announced with deep regret last week, the death of Hofrat Prof. Josef Maria Pernter took place after a long illness at Arco, South Tyrol, on December 20. From 1897 until compelled in the early part of last year to abandon his work, Pernter was professor of meteorology and geodynamics in the University of Vienna, and director of the Austrian Zentralanstalt for those sciences. The institute is situated in the Hohe Warte, about three miles from the centre of the city of Vienna.

He was born on March 15, 1848, in Neumarkt, Tyrol. In 1864 he entered the novitiate of the Society of Jesus, and became successively professor of philosophy at Presburg, professor of physics and mathematics at Kalócsá, Hungary, and at Kalksburg. He left the society in 1877, and in 1882 became an assistant in the Central Meteorological Institute of Vienna. In 1890 he was made professor of cosmical physics in Innsbruck, but returned to Vienna as director and professor upon the retirement of Hann. Throughout his life he was a sincere churchman, and occupied a position of great influence among Catholic university students.

His best known work is his "Meteorological Optics," an admirable and exhaustive treatise the publication of which is not yet completed. And apart from his official work as director of the Austrian Meteorological Service, there are many valuable papers by him on various branches of meteorology to be found in meteorological journals or in the publications of the Vienna Academy, of which he was a corresponding member. His friends will probably remember him best as a controversialist of the best kind. Himself full of vigour, energy and "Geist," he possessed the power of putting his ideas with perfect fairness into the most lucid and vigorous language, both in conversation and in print. His contributions to the discussion of the question of the cannonade against hail concluded with a masterly summary in "Das ende des Wetterschiessen's" in the *Meteorologische Zeitschrift* of 1907.

He was an active member of the International Meteorological Committee, and presided over the conference of directors of meteorological institutes and observatories at Innsbruck in 1905. His work, both official and unofficial, was characterised by great thoroughness and vivacity.

In recent years he suffered most poignant family bereavement. He lost his young daughter in 1904 and his wife in 1906, and from these losses he never recovered. He leaves an only son, who is still of student age.

NOTES.

M. P. VILLARD has been elected a member of the Paris Academy of Sciences, in the section of physics, in succession to the late M. Mascart.

PROF. A. BÉHAL, of the École supérieure de Pharmacie of Paris, has resigned the general secretaryship of the Paris Chemical Society. He will be succeeded by M. Freundler, of the faculty of science in the University of Paris.

MR. ARTHUR H. SMITH has been appointed keeper of the department of Greek and Roman antiquities in the British Museum, in succession to Mr. Cecil H. Smith, who was recently appointed director of the Victoria and Albert Museum.

AT the initiative of the Association internationale de l'Institut Marey, a subscription list has been opened for the erection of a monument to the late M. E. J. Marey. We learn from *La Nature* that donations may be sent to M. Carvallo, at the Institut Marey, Parc des Princes, Boulogne-sur-Seine. A committee of management has been formed, with M. Chauveau as chairman.

DR. H. W. WILEY, the chief of the bureau of chemistry in the U.S. Department of Agriculture, is directing atten-

tion to the need of isolating consumptives on railway journeys, particularly in travel by sleeping-car across the American continent. He is arranging apparatus to take samples of the air breathed in these cars for the purpose of analysis in the interest of the public health.

A GRATIFYING sign of the increased interest in hygiene in America is reported from Tuskegee, Alabama, where a meeting of the National Negro Anti-tuberculosis Congress was held on December 19, 1908. It was decided to begin the organisation of anti-tuberculosis committees in all negro lodges and business leagues. Hitherto, owing largely to the neglect of normal precautions, the mortality from consumption has been exceptionally high among the coloured population.

THE death is announced of Prof. Richard Pischel, who had occupied the chair of Sanskrit in the University of Berlin since 1902, and was elected a member of the Prussian Academy of Sciences in 1903. Prof. Pischel was born on January 18, 1849, and took his degree at Breslau in 1870. He was for ten years professor of comparative philology at Kiel, and was afterwards at Halle, from whence he was called to Berlin. His "Vedische Studien," published in conjunction with Geldner (1889–1901), played an important part in vindicating the specifically Indian character of the Rig-Veda.

THE Paris correspondent of the *Times* states that on December 31, 1908, Mr. Wilbur Wright accomplished at Le Mans a flight lasting 2h. 20m. 23·2s., the distance covered being officially returned at nearly 125 kilometres. A year ago Mr. Farman flew 1093 yards in 88 seconds, and now Mr. Wright has traversed 136,106 yards in 8423 seconds. There has thus been a decided advance both as regards duration of flight and distance covered. A Reuter message from Brussels states that King Leopold's prize of 25,000 francs (1000*l.*) will be awarded this year to the author of the best work on aërial navigation.

THE Berlin correspondent of the *Globe* states that a series of interesting experiments is being carried out by the German military authorities with regard to the employment of wireless telegraphy by balloons. These experiments are being made by means of registering balloons fitted with a wireless-telegraphy apparatus. When a message has been received by the balloon an ingenious mechanism opens the valve, and the balloon descends. The military authorities hope to be able soon to extend the working of wireless telegraphy to the military steerable balloons.

THE summary of the weather issued by the Meteorological Office for the week ending January 2 gives some interesting temperatures which occurred in the recent severe frost, to which reference was made in our issue last week. The summary states that the lowest of the minima were generally registered on December 29 or 30, and were so low as 3° at Swarraton, near Worthing, on December 30, 5° in the Midland counties, and 7° at Cambridge. Temperatures at other than the usual stations are also given. At Liphook, in Hampshire, about thirteen miles to the south of Aldershot, the thermometer in the screen fell to 1° below zero on December 30, at Buxton and Epsom to *plus* 4°, and at Great Billing, Northampton, to *plus* 6°. The thermometer exposed on the snow at Tunbridge Wells fell to 2° below zero, and at Epsom to 8° below zero. The temperature at Greenwich on the morning of December 30 fell to 12° in the screen, and to 2° on the grass. There have only been four winters during the last fifty years in which the sheltered thermometer has fallen below 12° at Greenwich, and the lowest temperature recorded is 6°·6, on January 5, 1867. Subsequent to the close of the frost on December 30 the weather has been unusually mild for the time of year over the entire kingdom, and the thaw was both sudden and complete.

THE weather statistics kept at Greenwich Observatory during 1908 show the year to have been generally one of normal conditions. The aggregate measurement of rain was 23·8 inches, which is 0·3 inch less than the average of the previous half-century. The largest measurement in any month was 3·66 inches, in July, which is 1·26 inches more than the average; the other months with an excess of rain were March, April, June, August, and December. The month of least rainfall was November, with 0·76 inch, which is 1·46 inches below the average; the deficiency in September was 0·93 inch, and in October 0·81 inch, giving a total deficiency of 3·20 inches for the three autumn months. There were in all 155 days with rain, the greatest number in any month being twenty, in December, and the least six, in June. Snow fell on twenty-three days during the year, and eight of these occurred in March. The mean air temperature for the year was 50°·1, which is in precise agreement with the average. The highest mean for any month was 63°·1, in July, and June and August each had the mean above 60°. The coldest month was January, with the mean 36°·3, which was 2°·1 below the average. The range of temperature was 72°, the absolutely highest reading being 84°, in July, and the lowest 12°, in the recent frost on December 30. Frost occurred in all on forty-four nights, and thirty-two of these occurred from January to March. The temperature was above the average on forty-six nights in the two months October and November, and there were only three nights with frost. The duration of bright sunshine was 1633 hours, which is 132 hours in excess of the average for the previous ten years; the most sunny month was June, and the least sunny December.

MR. F. L. DAMES, Steglitz, Berlin, has sent us copies of catalogues of works on entomology (No. 97) and botany (No. 98).

THE early development of the polycladian Planocera is discussed by Mr. F. M. Surface, who has sent us a copy of his paper, in the Proceedings of the Philadelphia Academy for December, 1907 (issued February, 1908). As the paper reaches us somewhat late, we are unable to refer to its contents.

MESSRS. MACMILLAN AND CO. have just published another of their series of coloured wall-pictures of farm animals, this being the portrait of the shire stallion champion "Hendre Royal Albert." This animal, which is a bay, with a white "blaze" and white "stockings," has been finely depicted by Mr. J. Macfarlane, the painter.

IN an article in the December (1908) number of *Naturen* Mr. O. Nordgaard is led to the conclusion, from the enormous numbers of flint-implements to be met with in certain parts of the country, that during the early human period Norway possessed a Cretaceous formation, which has now been denuded away.

IN NATURE for March 21, 1908, was published a notice, by Dr. P. L. Sclater, of a pamphlet by Mr. W. Rodier on the best means of exterminating rabbits in Australia, while a second notice was communicated by Mr. W. B. Tegetmeier to our issue of November 13, 1902. Both notices are commendatory of the plan, which consists in killing off the females, and thus causing a preponder-

ance of males, which will kill a considerable proportion of the largely diminished number of young. Mr. Rodier has favoured us with a new edition of his pamphlet, entitled "The Rabbit Pest in Australia," published in Melbourne.

The effect of alkaloids on the early development of the echinoderm *Toxopneustes variegatus* forms the subject of a paper by Mr. S. Morgulis published as No. 14 of Contributions from the Bermuda Biological Station. Previous experiments have shown that the addition to the water of small quantities of pilocarpine hydrochloride results in the increase of the size of the embryos in certain echinoderms, and it was thought that a further study of such abnormally large embryos might contribute information on the problem of growth. The new experiments did not yield the anticipated results, but the author nevertheless gives a summary of his work, which may not be devoid of interest.

Some interesting experiments on the action of radium rays on developing plants are described by Prof. C. S. Gagee in the December (1908) number of the *American Naturalist*. The general result of these is to demonstrate that radium rays act as a stimulus to plants. If this stimulus ranges between a minimum and an optimum point, an excitation function is the result, but when the optimum point is passed there ensues a depression of function, terminating in complete inhibition of growth as the strength or duration of the treatment is maintained above the point in question. The results of experiments on germinating lupin-seeds, Timothy grass, &c., are illustrated by means of photography as well as by diagrammatic curves.

Colony-formation among rotifers, according to Mr. F. M. Surface, to whom we are indebted for a separate copy of a paper from vol. xi., No. 4, of the Biological Bulletin, on the formation of new colonies in *Megalotrochoa alboflavicans*, is not common. In certain species of the family Melicertidæ the individuals do, however, become aggregated into colonies, the young being hatched as free-swimming units. In the case of the species described, these young do not leave the colony singly, but come together into a swimming ball which reacts positively to light. Under certain conditions this ball subsequently breaks up into free individuals, which again collect into a permanent colony. In the formation of these colonies the mucus-like secretion of a gland plays an important part.

After the death of the great embryologist Prof. K. E. von Baer, there was found among his papers an unpublished biography of Cuvier, which is of very considerable interest as being an account of a great naturalist by one of his own contemporaries. The memoir was published, under the editorship of Prof. Ludwig Stieda, of Königsberg, in the *Archiv fur Anatomie* for 1896, and of this a French translation has appeared in the *Annales des Sciences naturelles, Zoologie*, for 1908. This biography, together with Eckermann's "Conversations avec Goethe dans les dernières Années de sa Vie," published at Magdebourg in 1848, forms the subject of an article by Dr. E. Trouessart entitled "Cuvier et Géoffroy Saint-Hilaire d'après les Naturalistes Allemands," of which the first part appears in the December (1908) issue of *La Revue des Idées*. The first-named of the two memoirs is somewhat severely criticised, the claim put forward by von Baer that Cuvier was in part a German by descent apparently exciting the ire of the French reviewer. A second article in the serial cited is devoted to a review, by Mr. Etienne Rabaud, of de Vries's mutation theory.

Mr. C. J. Herrick has favoured us with separate copies of two papers from vol. xiii., No. 2, of the *Journal of Comparative Neurology and Psychology*, one on the phylogenetic differentiation of the organs of smell and taste, and the other on the morphological subdivision of the brain. Smell and taste, as he points out, are the only two senses in vertebrates the receptive organs of which are adapted to respond directly to peripheral chemical excitation; and he concludes that the agencies which acted to produce these senses are to be sought primarily, not in the stimuli calling forth the reflexes, but rather in the character of the response evoked by the stimulus. In the second paper it is pointed out that whereas the subdivision of the human brain into regions, as made by the early anatomists on the foundation of gross external form, has a certain functional as well as morphological basis, when the attempt was made to study the regions thus named from a comparative point of view, the morphological defects of the scheme became at once apparent. Several alternative schemes have been suggested, but as none of these, in the opinion of the author, is satisfactory, he proposes a new one for the entire nervous system, which is split up into four primary divisions, viz. systema nervorum sympathicum, s. n. cerebro-spinale, s. n. periphericum, and s. n. centrale. For the divisions of the brain itself we must refer our readers to the original paper.

The second Bulletin of the Sleeping Sickness Bureau, edited by the director, Dr. A. G. Bagshawe, contains a summary of the results of the work hitherto published by investigators upon certain aspects of the sleeping-sickness problem, supplemented by statements based upon the editor's own experience in Africa, and by conclusions of a practical nature deduced from the array of facts brought together. The chief subjects dealt with in the present number are diagnosis and symptoms of human trypanosomiasis, transmission of *Trypanosoma gambiense*, incubation period of human trypanosomiasis, toxin-formation in trypanosome-infection, and recent work on treatment. With reference to the vexed question of the transmission of sleeping sickness, it is concluded that "in devising measures for prevention we may disregard other species and concentrate our attention and energies on *Glossina palpalis*." This publication is especially valuable for those who are investigating sleeping sickness far from centres of civilisation and scientific libraries, and require information with regard to the results of other workers in the same field.

A synopsis of the Philippine species of Freycinetia (Pandanaceæ), prepared by Mr. E. D. Merrill and published in the botanical series of the *Philippine Journal of Science* (No. 5), assigns twenty-four species to the islands, a number considerably greater than is found in any other region; moreover, they are all endemic. Of the species of Philippine oaks, which are summarised by the same author, most are endemic, but four species are common to the Celebes or Borneo. It is noted that one, a new species, sheds its bark in thin flakes similarly to the ordinary species of birch.

Quoting from his experience of insect pests in Indian forests, Mr. E. P. Stebbing communicates to the *Indian Forester* (November, 1908) cogent arguments regarding the danger of pure forests, and points out the necessity for taking into consideration the dangers of insect and plant pests before drawing up forest working plans. Special observations in the case of an attack by bark-borers on deodar showed that the ravages were considerably greater where the deodar formed pure forest than on

areas where the deodar was mixed with oak. Sometimes, as in the case of a species of Tomicus bark-beetle infesting blue pine and spruce, more than one of the principal trees in a mixed forest is attacked.

THE notes on annual flowers by Mr. A. Watkins published in the Journal of the Royal Horticultural Society (vol. xxxiv., part ii.) contain hints for the amateur gardener as well as queries for the plant breeder. The author observes that annuals well repay extra attention, especially in the matter of sowing and transplanting so as to give them plenty of room. As a puzzle in variation, reference is made to the Countess Spencer variety of sweet-pea, from which for a long time no fixed type could be obtained; the explanation offered attributes this difficulty to a period of variability for the strain. As a successful instance of selection, Mr. Watkins mentions his production of the Mandarin *erecta compacta* variety of Eschscholtzia.

THE report on the operations of the Department of Agriculture, Madras Presidency, for the official years 1906–7 and 1907–8 shows that steady progress is being made in improving the native husbandry. Experiments are recorded on the growth of paddy, the most valuable and important crop of the Presidency, of sugar-cane, jute, and agave. There are numerous experiments on cotton, some of the famous black cotton soils occurring in this region, and on methods of irrigation. The department keeps in touch with the native cultivator by sending out agricultural inspectors to help the ryots in their cultivation of the various crops; it also distributes seed superior to that in common use, and, in certain cases, gives premiums by way of encouragement to those natives who succeed with the improved methods.

THE Bureau of Soils of the United States Department of Agriculture has recently issued a Bulletin (No. 51), by Messrs. Patten and Gallagher, dealing with the absorption of vapours and gases by soils. The problem is very intricate, and is not likely to be solved until more light has been thrown on the constitution of colloids; in this respect it resembles many other soil problems. Although the present publication does not carry us much further, it serves a useful function in collecting a good deal of scattered work, and directing attention to a problem of great practical and scientific importance.

BULLETIN No. 80 of the North Dakota Agricultural College Experiment Station gives descriptions of the common weeds of North Dakota, and of the methods by which they may be eradicated. It is recommended that recourse should be had to spraying with solutions of either ferrous sulphate, copper sulphate, or sodium arsenite. Sodium arsenate cannot be recommended, since it does not dissolve with sufficient readiness. Spraying is not an uncommon practice in England, and it is on the increase; the necessity of saving labour compels the modern farmer to do by chemical means what his predecessor did by hand.

THE report of the director of agriculture of the Federated Malay States for the year 1907 which has just come to hand shows continued progress in many directions. The climate is probably unsurpassed for rapid growth of vegetation, but these conditions are also favourable to insect and fungoid pests, and the appointment of a Government mycologist will prove a useful step. There is, however, no chemist as yet. The agricultural work appears to be on useful lines, and calculated to aid materially the development of these States. Work has been done on padi and on cocoanuts, both highly valuable crops, but perhaps the most striking advance is seen in rubber cultivation. The acreages in the Federated Malay States (exclusive of those in Johor, Malacca, and Province Wellesley) have been as follows:—

Year	Acreage	Year	Acreage
1897	345	1903	11,239
1898	1,761	1904	19,239
1899	3,227	1905	43,338
1900	4,693	1906	85,492
1901	5,965	1907	126,235
1902	7,239		

There was in 1907 a marked fall in the price of rubber, which, however, only stimulated the planters to improve their methods and decrease the cost of production. The industry is very profitable; even the lowest price yet reached for plantation rubber is more than 100 per cent. above the cost of production. Experiments are in hand to discover still better methods of working and of coping with the root fungus *Fomes semitostus* and the termite *Termes gestroi*, which are at present the worst rubber pests.

PROF. T. J. J. SEE contributes to the Proceedings of the American Philosophical Society a further paper dealing with his interpretation of the cause of earthquakes and the origin of mountain ranges. The paper is illustrated with a series of very striking relief maps of the continents, taken from Frye's "Geography," which are intended to illustrate the author's contention that the highest mountain ranges border the deepest oceans. The series of memoirs by Prof. See, of which this is the last, may be regarded as part of the modern revolt against the doctrine which regarded the earth as an inert mass cooling by radiation into space, and attributed all changes which have taken place in it as due to secular contraction. We wonder whether his last paper may not also be an indication of a return to the fashion of the lengthy titles which delighted our forefathers of a century ago.

AN excellent custom prevails in America, which might well be imitated in other countries, that just when a special piece of scientific work is needed someone is always ready to defray the cost. This is the case with the investigation of the races of the Philippine Islands, which is due to the liberality of Mr. R. F. Cummings, of Chicago. The report on the Tinggian tribe by Mr. F. C. Cole, which is the first of the series, amply justifies the expenditure on the work. The Tinggians are a fairly civilised tribe, practising rice farming on a large scale, and occupying the subprovince of Abra. They are ruled by a tribal council, before which everyone, including all duly married women, may bring their grievances. They revere a sky spirit, known as Kadaklan, but their religious rites are mainly devoted to the propitiation of the evil spirits which infest the earth. These rites are in a large measure of the shamanistic type, and in their domestic ceremonies sympathetic magic plays a leading part. Special attention is paid to the propitiation of the spirits of the dead, for whom blankets and other things likely to be wanted in the other world are hung on a rope suspended over the corpse. Marriage is said to be prohibited between blood relations, and it is alleged that there is no clan system, an assertion which, on the analogy of other races in a similar grade of culture, further investigation will perhaps correct.

THE September (1908) number of the *Philippine Journal of Science* contains a classification of the racial types found among the students at the University of Michigan,

the percentage frequency in each class being stated. It is suggested that the numerous composite types may be explained by the action of inheritance from three primary types, in accordance with the lines laid down by Mendel.

L'Aéro Mécanique is the title of a new monthly paper published at Brussels (Rue royale 214). No. 5 before us contains, among other articles, one by Captain de Vos on the much-vexed question of the flapping wing of the bird, and extracts from current journals, patents, and so forth.

THE *Revue générale des Sciences* reproduces in its issue for December 15, 1908, the address given by Prof. H. Poincaré to the Mathematical Congress at Rome on "The Future of Mathematics." In the introductory part, which precedes the discussion of special regions of mathematical study, the author discusses the aims and objects of the pure mathematician, the reasons for his insistence on rigour and elegance in his proofs, and his relationship to the engineer.

THE equilibrium of a flexible string forms the subject of a paper in the Transactions of the American Mathematical Society, ix., 4, by Prof. E. B. Wilson. It is pointed out that the ordinary solutions for the cases of a rectilinear field, whether parallel or central, fail to lead to interesting problems when the string has a free end, but the paper shows that there is a large class of cases, which may be explicitly integrated by quadratures, where this objection does not apply.

A HISTORY of the origin of the theory of the æther is contributed by Dr. Léon Bloch to the *Revue générale des Sciences*, xix., 22. It deals very largely with the theories of Newton and Hooke. The author shows that as new physical discoveries have taken place, the theory of the æther has undergone a continual process of evolution, and he predicts that the same will take place in the future. A rigorous dynamical theory of this medium which does not admit of modification in the light of new discovery cannot be regarded as final.

PROF. E. B. WILSON, writing in the Bulletin of the American Mathematical Society (December, 1908), discusses the analogy between statistical mechanics and hydrodynamics, an analogy primarily based on the identity between the Eulerian equation of continuity and the corresponding relation between the differential coefficients of momenta and coordinates. According to this view, it is obvious that the determinantal relation of the kinetic theory represents the Lagrangian equation of continuity. The purpose of the paper is to examine whether the equations of motion, and in particular those of irrotational motion, have any analogues on the dynamical side. The search does not appear to lead to any results of great importance so far.

MESSRS. BURROUGHS WELLCOME AND CO. have sent us a copy of Wellcome's "Photographic Exposure Record and Diary" for the year 1909, and an examination of it shows that in this handy little book the owner possesses a store of practical information in the smallest compass for one shilling. In this year's issue a further attempt has been made, and we think with very successful results, to condense statements to the minimum number of words, and this has allowed extra matter on other subjects to be inserted. A new feature of the article on exposure is the insertion of two tables dealing with the relative speed of bromide papers and lantern plates. These should be found very useful, because if the user knows the correct exposure for any one of these, that for any other can be determined at a glance. Other items here tabulated are the various exposures of interiors, copying and enlarging, moving objects, &c., and an excellent list of plate speeds, brought up to date, is added. Perhaps the main feature of this pocket-book is the exposure calculator at the end, which by this time has become of such general use. In this issue the series of illustrations of characteristic subjects is printed on a separate card and placed in the pocket of the book, the use of the calculator being thus facilitated.

WE have received from Messrs. John J. Griffin and Sons, Ltd., of Kingsway, London, a conveniently arranged and profusely illustrated catalogue of models for teaching machine construction and drawing, pattern making and foundry practice, building construction, and mining operations. Teachers of these subjects should find the catalogue of great assistance and very suggestive in developing the practical side of the instruction they give.

WHITAKER'S "Peerage, Baronetage, Knightage, and Companionage for the Year 1909" is now available. The character of this useful work of reference is too well known to make any extended description of its contents necessary. A new feature of the present issue is an addition to the introduction in the form of an "Official Glossary," which provides useful information to persons who are not experts in the various departments with which the volume deals. The work includes an extended list of the Royal Family, the peerage with titled issue, dowager ladies, baronets, knights and companions, home and colonial bishops, and an index to country seats.

MESSRS. ARCHIBALD CONSTABLE AND CO., LTD., have published a revised and abridged edition of "The Life Story of Sir Charles Tilston Bright, Civil Engineer; with which is Incorporated the Story of the Atlantic Cable and the First Telegraph to India and the Colonies." The present volume has been prepared by Mr. Charles Bright alone, who, in the task of writing the original work, was assisted by his uncle, Mr. E. B. Bright. The book was reviewed at length, soon after its original appearance, in NATURE for October 26, 1899 (vol. lx., p. 613). This abridgment appears appropriately, since 1908 was the fiftieth anniversary of the Atlantic cable, and the short account of the work of so exceptionally able, energetic, and enthusiastic a man as the late Sir Charles Bright should be welcome to many readers. The price of the new issue is 12*s*. 6*d*. net.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JANUARY:—

Jan. 7. 13h. 21m. to 16h. 41m. Transit of Jupiter's Satellite III. (Ganymede).
10. 19h. Jupiter in conjunction with the Moon. (Jupiter 4° 11′ S.).
11. 14h. 23m. to 15h. 32m. Moon occults ν Virginis (mag. 4·2).
22. 9h 41m. to 13h. 32m. Transit of Jupiter's Satellite IV. (Callisto).
23. 0h. 12m. Minimum of Algol (β Persei).
25. 5h. 59m. to 7h. 2m. Moon occults 30 Piscium (mag. 4·7).
,, 7h. 44m. to 8h. 37m. Moon occults 33 Piscium (mag. 4·6).
26. 6h. 1m. Minimum of Algol (β Persei).
,, 16h. Mercury at greatest elongation, 18° 25′ E.
30. 20h. Mercury in conjunction with Uranus. (Mercury 0° 21′ N.).

COMET MOREHOUSE, 1908c.—From Mr. R. C. Johnson, one of the secretaries of the Liverpool Astronomical Society, we have received an enlarged copy of an excellent photograph of Morehouse's comet, taken by him, at his observatory at West Kirby, on November 15, 1908. The original photograph is one of a series of twenty taken with a $6\frac{3}{8}$-inch reflector of 28 inches focal length, and received 42 minutes' exposure, from 5h. 42m. to 6h. 24m. (G.M.T.).

The main streamer of the tail is very bright for a distance of about 40′ from the head, and extends to the edge of the plate, about $3\frac{1}{2}$ degrees; at the end of the bright portion this streamer divides into three distinct branches, in each of which there are several convolutions. In addition to this, there are several shorter streamers, two of which curve towards the south.

Numerous observations of this comet, made between September 18 and October 30, 1908, at the Royal Observatory, Rome, are reported in No. 4293 of the *Astronomische Nachrichten* (p. 331, December 27, 1908), and afford further evidence of the remarkable changes which took place in the form and brightness of the tail.

An ephemeris, covering the period January 13 to July 13, in ten-day intervals, appears in Circular No. 144 of the Harvard College Observatory. By the beginning of June, when the comet again reaches a declination observable in these latitudes, its computed brightness will be but about one-third that at the time of discovery.

A photograph of the spectrum of the comet, taken with the 8-inch Draper telescope on November 17, 1908, shows six broad bright bands which appear to coincide with $H\zeta$, $H\epsilon$, $H\delta$, $H\gamma$, $H\beta$, and the band at λ 464–473, characteristic of the spectra of stars of the fifth type (Harvard College Observatory, Circular No. 145).

THE TOTAL SOLAR ECLIPSE OF 1911 APRIL 28.—In a reprint from vol. lxix. of the Monthly Notices (R.A.S.), pp. 30–32, with which the author has favoured us, Dr. Downing sets out the conditions for the total solar eclipse of April 28, 1911, as it will be observed at Neiafu, a port on the south-west coast of Vavau Island, one of the Tonga group. At this station totality will last about 3m. 37s., the altitude and azimuth (from N.) of the sun being 43° and 49° respectively. Mail steamers from Sydney call at Neiafu every four weeks, and the town is the headquarters of the Governor and of several English and German trading firms.

A SIXTH TYPE OF STELLAR SPECTRA.—In Circular No. 145 of the Harvard College Observatory Prof. Pickering suggests that, for the purpose of facilitating reference to them, a number of stars already announced as having "peculiar" spectra should be assigned a class to themselves. This class would include a number of doubtful fourth-type stars, the spectra of which contain rays of much shorter wave-length than those of the normal fourth type; stars having spectra somewhat similar to those of the fifth type, but with the bright bands apparently reversed on a continuous spectrum; and stars of which the spectra are generally similar to the above, but show minor peculiarities.

It is proposed that the new class should be designated type VI., class R, and Prof. Pickering publishes a list of fifty-one stars all of which would certainly be included in this class; none of these is brighter than magnitude 7·5. Several of the spectra of this type are reproduced in the circular, together with spectra of types I., IV., and V. for comparison.

THE ASTRONOMICAL AND ASTROPHYSICAL SOCIETY OF AMERICA.—A brief *résumé* of the proceedings of this society, at its ninth meeting held at Put-in-Bay, Ohio, August 25–8, 1908, is published by Messrs. Jacoby and Sears in *Science* for December 11, 1908 (N.S., vol. xxviii., No. 728). Two special committees were appointed, one to deal with the question of luminous meteors, the other to consider comets.

Brief abstracts of many of the papers read at the meeting are published in *Science*, but they are too numerous to be discussed here; mention of some of them has already been made in these columns.

SPECTROSCOPIC BINARIES.—In No. 5, vol. ii., of the Journal of the Royal Astronomical Society of Canada Mr. Plaskett announces that spectrograms taken at the Dominion Observatory, Ottawa, show that γ Aquarii and ι Andromedæ are spectroscopic binaries.

Spectrograms of the former, taken during July and August, 1908, indicate a variation in the radial velocity between -40 km. and $+23$ km., whilst spectrograms of the latter, taken in August and October, 1908, indicate a range from -11 km. to $+32$ km.

THE VARIABLE STAR U GEMINORUM.—The third volume of *Recherches astronomiques de l'Observatoire d'Utrecht* is devoted to a very full discussion, by M. J. van der Bilt, of observations of U Geminorum, made between 1856 and 1907. This discussion occupies 115 pages, and is accompanied by twenty-seven plates giving the variously derived light-curves, one plate showing the normal curves of the long and the short maxima, and a final plate reproducing a chart of the stars surrounding this peculiar variable.

At the end of the discussion the author strongly emphasises the necessity for making constant observations of this star if its peculiarities and apparent anomalies are to be completely understood.

In the preface, Prof. Nijland states that whilst the first of these "Recherches" appeared in 1864, it is hoped that in future the volumes will appear at shorter intervals; vol. iv., dealing with observations of Jupiter, is already in the press.

THE HEAVENS AT A GLANCE.—Mr. Mee's handy card calendar for 1909 is similar to its predecessors in giving a great deal of useful astronomical information in a very compact form. For amateurs who wish to keep *au courant* with astronomical events, this calendar is an extremely useful aid, and may be obtained from Mr. Mee, Llanishen, Cardiff, for sevenpence, post free.

SURVIVALS OF PAGAN BELIEFS AMONG THE INDIANS OF SOUTH CALIFORNIA.

THE Luiseño Indians of South California, who with the kindred Diegueño tribe are the only survivors of those attached to the Franciscan missions, form the subject of a monograph by Miss C. B. DuBois, issued in the third bulletin of the eighth volume of the ethnological publications of the University of California.

Though they have been exposed to European influence for more than a hundred years, and have lived for nearly two generations under rigid Christian discipline, it is remarkable that so many of their pagan beliefs and customs have survived. It is still more noteworthy that, about a hundred and twenty years ago, a pagan missionary movement extended from them to the Diegueño tribe, among whom the new cult which centres round the personality of Chungichnish was introduced. This new faith, like others which have extended beyond their original home, had every requisite of a conquering religion—a distinct and difficult rule of life demanding obedience, fasting, and self-sacrifice—and it enforced its commands by an appeal to the fear of punishment, a threat that avengers in the shape of stinging weeds, the rattle-snake and the bear would punish neglect of its observances.

The most important of the rites connected with the Chungichnish cultus is that of Toloache, or the initiation of youths and girls. In the case of the former, the candidates, in a state of nudity, are dosed with a decoction of the jimson-weed (*Datura meteloides*), which contains a powerful narcotic and excitative principle. After the intoxication produced by this drug has passed away, the secret dances of the tribe are performed and the mystic songs are sung. The Shaman who conducts the proceedings asserts that he is possessed of magical powers, and the initiates are instructed to imitate his feats. During the dance the performers appear to speak in the tongues of beasts and birds, a rite possibly connected with a belief in personal totem animals or guardian spirits, which up to quite recent times survived among this people. These rites are followed by a fast from salt and meat sometimes lasting two or three weeks, and meanwhile the youth is instructed in the tribal code of etiquette and morals. He is told, for instance, that no one should eat immediately

on rising lest the spirit which was absent from his body in sleep should be unable to return. On the same principle, on return from an expedition into the hills he must defer eating so as to permit the wandering spirit to rejoin its mortal body.

This initiation rite is accompanied by an elaborate symbolism, of which Wanuwat, or the sacred net, and a form of painting or modelling in sand are the most prominent features. The net is said to symbolise the Milky Way, a prominent feature in the night sky of that region, which is regarded as the home of the dead; and the main idea seems to be based upon an attempt to free the departed spirits from this earth, and to prevent their return by binding them in the net of the Milky Way. The sand painting may perhaps best be described as a cosmological model in which the tribal conception of the relation of this world to the heavens is portrayed.

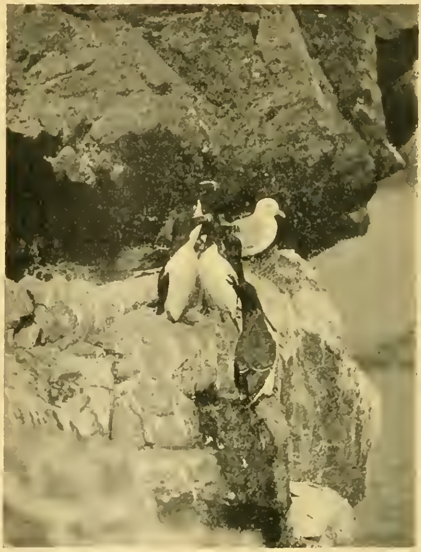
The annual commemorative rite for the dead is performed over images representing the departed, a custom common to the Hindus and other savage or semi-savage races. Singing and dancing, with whirling of the bull-roarer, precede the burning of the images, in some cases the clothing and ornaments being consumed, in others removed by the friends. Like the rite of the sacred net, the intention seems to be to expel the spirits of the dead from the neighbourhood of the living.

The Creation legends of the tribe, now for the first time fully recorded by Miss DuBois, are of considerable importance, and must be taken into account by all students of comparative mythology. In the beginning existed only Kivish Atakvish, the Void, who was followed by Whaikut Piwkut, "the whitish gray," who created two great round balls, which were male and female. The union of Sky and Earth then produced the First People, now represented by the magic mortar, wampum strings, the mat used in the death rites, and other sacred objects, animal and vegetable. Then appears a deified hero, Oniot, who is done to death by Wahawut, the witch, and, as in the Hindu Yama saga, death thus entered the world. Besides these is a group of interesting sky myths. The remarkable element in these legends is that they imply a succession of births or existences, some of them psychic, up to the present hardly known in native American thought, and Mr. Kroeber, the editor of the report, goes so far as to suggest that they represent Oceanic or Asiatic influence. But it must be remembered that these rites and legends have been for the first time recorded at a very late period in the history of the tribe, when it had been for a long period exposed to foreign influences. Possibly much of this elaborate symbolism is of native origin, but the interpretation of them now explained by the few survivors of the tribe who were initiated into the mysteries is somewhat obscure, and may not be really primitive.

A strong case can undoubtedly be made out for the independent origin of native American culture, and the theory of early historical relations between its races and those of Asia is beset by enormous difficulties. On the whole, it seems probable that the interpretation of these Luiseño myths will not lead to a modification of the view generally accepted by anthropologists, that they are of indigenous growth. The question is, however, not free from difficulty. They are in themselves of great interest, deserve attentive study, and their collection is another debt which ethnologists owe to the enterprise of the anthropological department of the University of California.

FIELD NATURAL HISTORY.

TO the Transactions of the Edinburgh Field Naturalists' and Microscopical Society, vol. vi., part i., Mr. J. C. Adam has contributed a charmingly written and exquisitely illustrated account of the bird-life of an outlying, and consequently little frequented, island in the Outer Hebrides group. After remarking how little of interest in the way of bird-life is noticeable from the single village, the author proceeds to give his experiences of the purple sandpiper, of which several specimens, in what appeared to be the breeding-plumage, were observed on the high ground of the interior, where it was hoped they would be found nesting. Careful search failed, however, to bring eggs to light, while the actions of the birds themselves did not suggest that they were breeding. On the sea-cliffs the birds absolutely swarmed. The lower levels, at a height of 100 feet, or occasionally 200 feet, form the resort of the oyster-catcher. "Beyond the oyster-catchers' territory was the domain of the big-gulls—the herring and the lesser black-backs; in fact, their respective spheres of influence encroached upon one another, and the clamorous cloud of swirling gulls, which even encanopied the intruder, were invariably 'threaded' by the high-pitched, piercing notes of a 'sea-pie.' The herring gull was by far the most abundant species. . . . When you had passed within the dominion of the gulls, you were on the brink of the cliff-wall, and from some coign of vantage might look down on the perpetual wonder and prodigality of a rock-fowl city. For sheer impressiveness you were perhaps wise to choose a stance as far down as you could reach in one of the great chasms which the ceaseless grind of the tide and the stress of Atlantic weather had gnawed into the very vitals of the island." One of the illustrations from this paper is here reproduced.



Razorbills and Kittiwake. From the "Bird life of an Outer Island."

To the same Transactions Mr. R. Service contributes some interesting observations on variation in the mole. The largest male obtained measured $7\frac{3}{4}$ inches in length, but an inch less than this still indicates a large individual; $5\frac{1}{2}$ inches is about the average for the female, the maximum observed being $6\frac{1}{4}$ inches. Great variation in the tint of black individuals is noticeable. As regards more striking colour-variation, the commonest abnormality is cream-colour, ranging from pale cream to deep rusty yellow, but a comparatively common phase shows a patch of yellow or rufous on the breast or abdomen, or on both. In some instances the light area extends over the whole of the under-parts, while in other cases it takes the form of a narrow or broad line down the middle of the same region, but in all individuals the light area has a longitudinal extension, and it is always sharply defined from the dark parts. A really white mole is very rare. There seems little doubt that the tendency to colour-variation runs in particular families of moles.

HIGHER EDUCATION IN LONDON.[1]

THE London County Council wholly maintains fifteen institutions in which instruction in science, art, and technology is given. The number of students at the council's various technical institutes enrolled up to the end of March, 1908, was 6527, as compared with 6215, and the number in attendance during that month was 4436, as compared with 4152 for the corresponding period of 1907. The number of day students enrolled for the same period in 1908 was 1702, as compared with 1455 for 1907, of whom 1337 were in attendance, as compared with 1109 for 1907.

In addition to providing institutions, the council partly maintains by money grants many other educational centres offering technical, scientific, or art instruction. The grants to polytechnic and kindred institutions are based on a variety of considerations, including the provision of special instruction and the attendance at classes, but the total contribution to any one polytechnic is not in any one year to exceed 7500*l.*, or any smaller sum actually required to enable the governors to meet their liabilities for the period for which the grant is made.

The ten polytechnics to which the council makes grants are distributed all over the county, and comprise the Battersea Polytechnic, the Borough Polytechnic, and the Woolwich Polytechnic on the south, and the Birkbeck College, City of London College, Northampton Polytechnic Institute, Northern Polytechnic, Regent Street Polytechnic, Sir John Cass Technical Institute, and South-Western Polytechnic on the north side of the River Thames. The instruction given in these institutions is of a very varied character, including such subjects as geometry, building construction, mathematics, modern languages, mechanical engineering, electrical engineering, tanning, leather, paint and varnish trades, carpentry and joinery, plumbing, other building trade subjects, including brickwork and masonry, experimental physics, and organic and inorganic chemistry. Where art classes are held special attention is given to the development of the classes on craft lines. The council, by virtue of its large grants in aid, appoints representatives upon the governing body or the committee of management of the several institutions.

For the last completed year (July 31, 1907) the grants to the institutions of polytechnic rank amounted to 68,233*l.*, or 33·4 per cent. of their total income from all sources. Building grants amounting to 9401*l.* were also made in the same period, and equipment grants 9125*l.*, making a total of 86,759*l.*, or 39·6 per cent. of total income, against 40·2 per cent. for the preceding year.

Grants are made to the governors of various polytechnics and technical institutions in aid of equipment required for continuing the work of such institutions at a high point of educational efficiency, having regard to the most recent scientific technological developments.

In addition to the ten polytechnics referred to above, equipment and maintenance grants in aid of the various classes in science, art, technology, and certain other subjects were made to the governors or committees of eighteen other institutions under the council's regulations relating to aid to evening classes in science, art, and technology. The actual grants—building equipment and maintenance—to all institutions in the session 1906–7 amounted to 86,759*l.* The estimated grant for the financial year was 115,476*l.*, as compared with 110,000*l.*, the estimated grant for the year 1907–8. The total number of individual students attending institutions of polytechnic rank aided by the council during the year 1907–8 was 27,275.

Attention has also been given to the extension of facilities for such technical instruction of boys in the daytime as would serve as a connecting link between secondary and higher elementary schools and the higher technical college or university, or would offer facilities for preliminary training in the daytime for those who intend to enter the engineering and allied trades, or trades where skilled workers in artistic crafts are required. Such day technical schools are intended to be auxiliary, and not alternative, to apprenticeship, and their object is to train future foremen, managers, and especially expert workers. So far as possible, the students will be drawn from the higher elementary and secondary schools at the age of fifteen, and they will receive special instruction during a period of two years. The curriculum will include instruction in science, drawing, modelling, English and general subjects, and workshop practice with distinctive trade bias, about half the time each week being devoted to the latter, but no attempt will be made to train fully for any particular trade. The workshop practice will be so arranged as to give the students a fair knowledge of workshop tools and processes. By means of such classes it is hoped that the gap between leaving day school and apprenticeship will be filled in such a manner as to enable the boys afterwards to acquire their practical experience readily and thoroughly, and that the boys will have learned a great deal more of the principles upon which the practice of mechanical engineering depends than could be learned by them if they entered the works at the age of fourteen.

The place of the polytechnics in any general scheme of coordination of technical education in the county, and their place in any scheme for the coordination of all types and grades of education, are matters of grave importance. The necessity for greater coordination between the work of polytechnics themselves, and the concentration of their efforts on carefully graded schemes of instruction in particular subjects, are matters which will receive careful consideration with the view of the prevention of overlapping and the determining of the sphere of work of each particular institution. The constantly improving means of communication between various parts of London will render possible coordination on these lines, as the isolation of the institutions, which has hitherto been a serious bar, no longer exists.

The importance of obtaining definite information relating to the students admitted to the polytechnics, technical institutes, and schools of art aided or maintained by the council, the age at which they enter, the duration of the period they are under instruction, the courses of study followed, their progress and the occupations they intend to follow, has long been recognised as being of great value in the solution of the problem. No systematic inquiries can at present be made so far as evening students are concerned, owing to the large amount of labour which would be entailed upon the officials of the institutes concerned, and the disinclination of the students to furnish the desired information. The governors of the various aided institutions have, therefore, been asked to supply the information for day students only.

The steady increase in the number of students for instruction in scientific, technical, and artistic subjects has necessitated careful consideration of the question of the provision of further facilities for such instruction, both immediately and in future years. In dealing with this matter the committee has been guided by the experience of past years, the extension of such work to meet the requirements of modern science and industrial development, the large increases each year in the number of students in attendance at the various institutions, the needs of particular districts, and, finally, the cost both in respect of capital and maintenance expenditure of such institutions.

The council's scholarship scheme provides for the award of about 2000 junior county scholarships annually, one-third to boys and two-thirds to girls, to those candidates who prove themselves qualified to receive secondary education. A junior county scholarship consists of free education for a period of three years, subject to renewal for two years more, provided that the scholar is satisfactory in conduct and attainments. A maintenance allowance of 6*l.*, 10*l.*, or 15*l.* a year is attached to the scholarship in cases falling within prescribed regulations. Junior county scholarships are tenable in such secondary schools as are or may be conducted by the council itself, and in such others as the council may from time to time approve for the purpose; 1899 such scholarships were awarded in the year under review.

A return is submitted annually to the council showing the incomes of the parents of junior county scholarship holders. The following table shows the incomes of the parents of scholars elected in July, 1907:—

[1] Extracted from the Annual Report of the Proceedings of the London County Council for the year ended March 31, 1908, published in December, 1908.

Annual income of parents	Boys		Girls		Total	
	No.	Per cent.	No.	Per cent.	No.	Per cent.
Less than £160 ...	604	82·1	1062	85·5	1666	84·2
More than £160 and less than £300 ...	99	13·4	151	12	250	12·6
Above £300	33	4·5	31	2·5	64	3·2
Total...	736	—	1244	—	1980	—

Up to 1906 the council offered 1200 probationer scholarships, without income limit, of the value of 15*l*. a year, in addition to free education. These scholarships are tenable for one or two years, and are awarded on condition that the scholars undertake to enter the teaching profession on the completion of the scholarship course. During the year the council awarded 749 such scholarships, together with twenty-eight free places at secondary schools, to students residing outside the county. From 1907 provision will be made for the award of only 800 such scholarships, and the actual number awarded each year may not amount to this number.

The council awards 100 intermediate county scholarships annually to pupils between fifteen and seventeen years of age, tenable until the end of the school year in which the pupils attain the age of eighteen, with possibilities of extension for another year. During the year seventy such scholarships were awarded to boys (including twenty commercial intermediate scholarships) and thirty to girls. The scholarships consist of free education at a cost not exceeding 25*l*. a year, together with maintenance grants rising from 20*l*. a year to 35*l*. a year. The income restriction is 400*l*. a year. The commercial scholarships are tenable in the commercial department of the Camden or Hackney Downs London County Council secondary schools.

The council awards fifty senior county scholarships or exhibitions annually; they confer free education (not exceeding 30*l*. a year) and such maintenance allowance (not exceeding 60*l*. a year), at such rate and for such periods, not exceeding four years, as the council may in each case determine. They are tenable at such universities or university colleges as the council may from time to time approve for that purpose, not more than five such scholarships awarded annually being tenable for one year at the London Day Training College. The council has also at its disposal a certain number of free places for day students at schools of the University of London. As the number of applications was not so great as in previous years, the council awarded during the year thirty-nine senior county scholarships and exhibitions, together with fourteen free places at various colleges.

It is generally admitted that the scholarship systems, both of the late Technical Education Board and of the council, have been remarkably successful. The county scholarship system has really formed a ladder to carry promising scholars from the public elementary to the secondary schools, university colleges, and universities. That the council has secured able candidates for its scholarships is shown by the fact that each year the council's scholars have obtained scholarships in the universities or institutions of university rank. Five such scholarships were obtained at Oxford and Cambridge during the year under review, and many senior county scholars have obtained degrees with honours.

On the more technical side, exceptional distinction has been gained by scholars in research work, while others have obtained good appointments owing to their technical and artistic achievements.

By the regulations of the Board of Education a secondary school "must offer to each of its scholars an education of a wider scope and higher grade than that of an elementary school, and provide a progressive course of instruction (with the requisite organisation, teaching staff, curriculum, and equipment) in the subjects necessary to a good general education upon lines suitable for scholars of an age-range at least as wide as from twelve to sixteen or seventeen. Provision made for scholars before the age of twelve must be similarly suitable, and in proper relation to the work done in the main portion of the school." The pressing need for further inducements and facilities for children to proceed to a secondary school after leaving the elementary school has long been recognised by the council, and by means of a system of scholarships a bridge by which even the poorest children may pass from the elementary to the secondary school has been provided. The course of instruction in secondary schools, approved by the Board of Education, is framed so as to lead up to a definite standard of attainment, and not to stop short at a merely superficial introduction to any branch of instruction.

Apart from the council's own secondary schools, there are a large number of secondary schools in respect of which the council makes both maintenance and equipment grants, and which are regularly inspected by the council's officers; the total number of such schools is now fifty-two. The total amount of grants made in respect of secondary schools for the educational year ending July, 1908, was 93,970*l*.

In accordance with a scheme approved by the late Technical Education Board in 1902, the annual grant of 10,000*l*. to the University of London, to be divided equally between the four faculties of arts, science, engineering, and economics, has been continued. In addition, annual grants have been made since 1895–6, together with occasional equipment grants, to four of the constituent colleges of the University, the council thereby obtaining the right to a certain number of free places.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

It is proposed, says *Science*, to collect 1500*l*. with which to purchase the valuable chemical library of the late Prof. W. O. Atwater, and present it to Wesleyan University, Middletown, Conn. The library contains more than 5000 volumes, including about 2500 volumes of periodicals.

Two courses for teachers, arranged in connection with the London County Council Education Committee, will begin at University College on January 23. Dr. Woodland will begin a course of lectures on "The Structure and Natural History of some Common Animals," and Dr. Fritsch will begin a similar course on "Fundamental Principles of Botany." On Tuesday, February 23, Prof. Pearson will deliver a lecture on "The Purport of the Science of Eugenics." This will be the first of a course of lectures on national eugenics, to be given on Tuesdays in the second and third terms, by Prof. Pearson, Mr. Heron, and Miss Elderton.

The annual meeting of the Public School Science Masters' Association will be held at Merchant Taylors' School, Charterhouse Square, E.C., on January 12. In the morning, at 10 a.m., an exhibition of scientific apparatus and books will be opened, and at 10.30 a business meeting will be held. The president, Sir Clifford Allbutt, K.C.B., F.R.S., will afterwards deliver an address upon the relation of general to technical science teaching. At the close of the morning session Mr. M. D. Hill, of Eton College, will speak on anthropometry in schools. The afternoon meeting will be devoted largely to a discussion upon science curricula in public schools, and the debate will be opened by the following papers:—Mr. G. F. Daniell, on the report of the British Association upon the sequence of studies in science; Mr. W. D. Eggar, of Eton College, on geography considered as a science subject; Mr. R. G. Durrant, of Marlborough College, on to what extent and at what stage should prevalent views on the nature of solution be taught in schools; and Mr. G. H. Martin, of Bradford Grammar School, on science for the "classical side." At the close of the discussion, Mr. C. I. Gardiner, of Cheltenham College, will deal with the question of the refusal of the General Medical Council to recognise public schools as institutions where medical education can be commenced.

THE annual meeting of the Association of Directors and Secretaries for Education was held on January 1 in the council chamber of the London County Council, when an address on "The Finances of Education" was delivered by Mr. W. Avery Adams, chairman of the association and secretary to the Bristol Education Committee. In opening his address, Mr. Adams said that the scheme for raising the Bristol University College to the rank of a university, owing to the generosity of Mr. H. O. Wills, promises shortly to be carried into effect, thus securing for the west of England the same opportunities for intellectual and professional training as are available in other parts of the country. Alluding to the Scottish Education Act, he directed attention to the powers which are to be granted to school boards in Scotland to compel attendance at continuation classes up to the age of seventeen. If such a remedy for the educational leakage which now went on is practicable in Scotland, said Mr. Adams, surely it is not unreasonable to suggest that it is practicable in England. The principal theme of the address was the finances of education, and Mr. Adams insisted that one of the chief hindrances to progress is the financial strain now put upon the local education authorities (1) by the imposition on the part of the State of new and onerous duties; (2) by the continual growth of what may be termed the ordinary items of expenditure; and (3) by the failure of Whitehall to contribute a fair share of the total burden of the increasing cost. The development of our educational system, which has advanced enormously during the last six years, has also entailed a large annual increment to the rates; and, apart from what has already been accomplished, there are still many urgent educational reforms which would doubtless be undertaken by local authorities if it were not for the reluctance of Whitehall to bear a fair share of the cost involved in carrying out the improvements. Among these reforms may be placed:—(1) the reduction in the size of the classes; and (2) the replacement of supplementary teachers by certificated teachers. The Government grant in support of national elementary education is totally inadequate. In conclusion, Mr. Adams emphasised the fact that the exiguous grant given by the State to the local universities, which have now become an indispensable part of our educational system, is not creditable to a wealthy and progressive nation like ours. The outcry heard against the growing burden of the cost of education is not the expression of a spirit of grant-greed, but represents a fear that through inadequate Government support the schools may send forth scholars who will not be equipped properly for the warfare of life or for taking their part in the struggle which has to be made unceasingly for the maintenance of the commercial and industrial position of our nation.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 12, 1908.—"The Occlusion of the Residual Gas and the Fluorescence of the Glass Walls of Crookes Tubes." By Alan A. Campbell **Swinton**. Communicated by Sir William Crookes, F.R.S.

In a previous paper[1] the writer has described experiments indicating that the occlusion of the gas is due to its being driven into the glass, in which it forms bubbles on subsequent heating.

The present paper deals with Mr. Robert Pohl's suggestion that the bubbles are not due to the gas at all, but to chemical action on the glass, when heated, of aluminium disintegrated from the electrodes.

The author finds that after prolonged sparking portions of the internal surface of the glass of tubes with external electrodes consisting of caps of tinfoil show numerous but very small bubbles when heated. This, as it would seem, entirely disposes of Mr. Pohl's contention.

The electric discharges passed through the tubes were so weak that the heating of the glass was very slight. The temperature cannot thus have been sufficiently raised either to allow of the gas passing into the glass by ordinary diffusion, as suggested by Sir J. J. Thomson, or of the gas being evolved inside the glass by chemical decomposition due to heat, as put forward by Mr. Soddy and Mr. Mackenzie.

Grinding away the glass to the extent just necessary to prevent the formation of bubbles on subsequent heating also showed that the depth to which the gas is driven into the glass varied from 0·0025 mm. for tubes with external electrodes to as much as 0·015 mm. with internal electrodes, the distances being in all cases considerably less—about one-tenth—than the distances between the surface of the glass and the centres of the bubbles produced by subsequent heating.

By means of a fluorescent screen placed behind a patchwork screen of different thicknesses of aluminium foil, it was ascertained that the maximum thickness of aluminium through which kathode rays will pass is about 0·014 mm., which agrees very fairly with the above-mentioned figure of 0·015 mm.

Thus neither the explanation of Sir J. J. Thomson nor that of Mr. Soddy and Mr. Mackenzie seem necessary, for the gas in the first instance travels into the glass only about the same distance that kathode rays penetrate into aluminium, and it is therefore reasonable to suppose that the gas is driven in mechanically according to the writer's original contention. Diffusion, however, probably takes place when the glass is softened in the flame, when the gas penetrates further and forms bubbles on cooling, in much the same way that air bubbles are formed in ice.

Experiments were also made on the fatigue of the glass in respect to fluorescence. Except in cases where this fatigue was due to deposits of electrode matter or of carbon, it was found necessary, in order to do away with it, to grind away a thickness of glass approximately the same as had to be removed to prevent the formation of bubbles on subsequent heating. It would therefore appear that fatigue is intimately connected with, and is perhaps the direct result of, the penetration and presence of the occluded gas. That part of this fatigue is very permanent is shown by a tube in the author's possession, which still shows fatigue due to bombardment it received in 1898. Though part of the fatigue is permanent, most of it is but temporary. This may be due to the gradual escape of such portion of the gas as has been driven into the glass only such a very short distance that the latter is unable permanently to retain it.

PARIS.

Academy of Sciences, December 28, 1908.—M. Bouchard in the chair.—The lava of the last eruptions of Vulcano, Eolian Isles: A. **Lacroix**. In the cases of Mt. Pelée, Vesuvius, and Etna it has been proved that in a given eruption any changes in the chemical composition of the lava are very slight, and are not systematic. Observations published by various authors on the products of the last eruption of Vulcano appear to lead to different conclusions. Various specimens of the lava from this eruption have been analysed, and the existence of such marked differences is not confirmed.—Some properties of the tubercle bacillus cultivated on bile: H. **Calmette** and C. **Guérin**. The authors are convinced that experiments in tuberculosis in which cultures in glycerol, gelatin, potato, or broth are used give different results from those of natural infection. They have found that the bacillus grows perfectly on pure bile with 5 per cent. of glycerin and sterilised, and after several successive cultures on this medium it acquires very distinct physiological characters. Full details are given of the mode of working and of the appearance and properties of the bacillus thus obtained. It is easily absorbed through the wall of the digestive tube, and when it has penetrated in sufficient quantity in this way it can create lesions with rapid calcification such as could never be obtained experimentally with cultures in ordinary glycerin media.—M. Villard was elected a member in the section of physics in the place of the late E. Mascart.—Concerning the distribution of the aphelia of the minor planets: Emile **Belot**. A diagram is given of the distribution.—The use of coloured screens and orthochromatic plates for the photographic observation of the fixed stars: Œsten **Bergstrand**. The combination of a yellow screen and an orthochromatic plate produces much greater clearness in the images, and also eliminates the

[1] "The Occlusion of the Residual Gas by the Glass Walls of Vacuum Tubes," Roy. Soc. Proc., A, vol. lxxix., pp. 134–7.

harmful influence of atmospheric refraction. It is to be recommended in all precise measurements of position, and especially in work on stellar parallax.—The principles of flight with wings: L. **Thouveny.**—A special model of a balloon: M. **Radiot.**—The problem of efforts in the theory of elasticity: A. **Korn.**—The magnetic rotatory power of the vapour of calcium fluoride and of nitrogen peroxide in the neighbourhood of their absorption bands: A. **Dufour.** The vapour of calcium fluoride in the magnetic field possesses a positive magnetic rotatory power outside and near the doublets of all the components of the band D″ and negative in their interior; the rotation may attain a value of 40° to 50° in the centre of the doublets. Similar observations on nitrogen peroxide are described.—The law of the maximum of kathode phosphorescence in binary systems: G. **Urbain.** It is now well established that, in opposition to the views of Sir W. Crookes, pure substances do not give rise to phosphorescence. A brilliant phosphorescence is always the result of a mixture of two substances, and there is a certain percentage of one of them which gives a maximum result.—The electrical resistance of the alkali metals, of gallium, and of tellurium: A. **Guntz** and W. **Broniewski.** These metals were introduced into a U-shaped capillary tube, with suitable precautions as to purity and freedom from oxidation. The resistances of cæsium, rubidium, potassium, sodium, and lithium were measured at −187°, −78°.3, 0°, and a fourth higher temperature, and the results compared with those calculated from the formula

$$r_t = (2F + T) \times \text{constant},$$

in which r_t is the resistance at the temperature t, F the absolute temperature of fusion, and T the absolute temperature of the body. Measurements are also given for gallium in both the solid and liquid state and for tellurium.—The reduction of uranyl chloride: Œchsner **de Coninck.** An attempt was made to determine the atomic weight of chlorine by reducing U_2OCl_2 in hydrogen at a red heat, but the results were found to be of no value.—The preparation of ether salts of the cyclic series: A. **Béhal.** A mixture of acetic acid and benzyl chloride, heated to the boiling point, slowly gives off hydrochloric acid, benzyl acetate being formed. The action is accelerated by the presence of certain catalytic agents, bismuth chloride being especially active in this respect.—The preparation and properties of β-gluco-heptite: L. H. **Philippe.** By reducing the gluco-heptonic lactone obtained from ordinary glucose with sodium amalgam, E. Fischer obtained β-gluco-heptose. The author, by pushing the reduction a stage further, has prepared a new heptavalent alcohol, β-gluco-heptite, the physical and chemical properties of which are given.—The facies of natural crystals: Paul **Gaubert.** The development of the perennial plant compared with that of the annual plant: G. **André.**—The presence of urea in some of the higher fungi: A. **Goris** and M. **Mascre.** Certain species of fungi have been found to contain from 2·7 to 4·3 per cent. of urea. It still remains to be proved whether the urea was present as such in the fungus, or was formed during the process of drying.—A new artificial peroxydase: E. **de Stœcklin.** Tannate of iron acts as a peroxydase, the monophenols being attacked with especial ease.—The green pigment of the bile: M. **Piettre.** The physiological function of the arborescent glands connected with the female generating apparatus of *Periplaneta orientalis*: L. **Bordas.**—The stratigraphical definition of the Sicilian stage: **Maurice Gignoux.**

DIARY OF SOCIETIES.

THURSDAY, JANUARY 7.

RÖNTGEN SOCIETY, at 8.15.—A Description of Three Sub-standards of Radio-activity recently prepared for the Röntgen Society: C. E. S. Phillips.—A New Localising Apparatus designed by Staff-Surgeon Dr. Gillett: H. C. Head.

FRIDAY, JANUARY 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—A New Dividing Engine: G. T. McCaw.—Fluctuations in the Moon's Mean Motion: Prof. Simon Newcomb.—Observations of Comet *c* 1908, Morehouse: R. C. Johnson.—Development of the Disturbing Function in Planetary Theory in Terms of the Mean Anomalies and Constant Elliptic Elements: P. H. Cowell.—Note on Major MacMahon's Paper on the Determination of the Apparent Diameter of a Fixed Star: A. S. Eddington.—*Probable Papers*: On a Chinese Planisphere: E. B. Knobel.—Observations of Occultations of Stars by the Moon in the Year 1908: Royal Observatory, Greenwich.—Observations of Saturn's Ninth Satellite, Phœbe, from Photographs taken with the 30-inch Reflector in 1908: Royal Observatory, Greenwich.

MONDAY, JANUARY 11.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

TUESDAY, JANUARY 12.

ZOOLOGICAL SOCIETY, at 8.30.—Zoological Results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunnington, 1904–5.—Report on the Copepoda: Prof. G. O. Sars.—Studies on the Flagellate Blood Parasites of Freshwater Fishes: Prof. E. A. Minchin.—A Further Note on the Gonadial Grooves of a Medusa, *Aurelia aurita*: T. Goodey.—The Tuberculin Test in Monkeys, with Notes on the Temperature of Mammals: Dr. A. E. Brown.—A few Notes on *Balaena glacialis* and its Capture in Recent Years in the North Atlantic by Norwegian Whalers: Prof. R. Collett.

WEDNESDAY, JANUARY 13.

GEOLOGICAL SOCIETY, at 8.—On Labradorite-Norite with Porphyritic Labradorite Crystals; a Contribution to the Study of the "Gabbroidal Eutecticum": Prof. Johan H. L. Vogt.—On the Genus Loxonema, with Descriptions of New Proterozoic Species: Mrs. Jane Longstaff.

SOCIETY OF PUBLIC ANALYSTS, at 8.—(1) The Analysis of Complex Candle Mixtures; (2) The Detection and Estimation of Mercury in Nitro-Explosives: Otto Hehner.

THURSDAY, JANUARY 14.

ROYAL SOCIETY, at 4.30.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The G. B. System from a Tramway Manager's Point of View: Stanley Clegg.

FRIDAY, JANUARY 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Filtration and Purification of Water for Public Supply: John Don.

CONTENTS.

THURSDAY, JANUARY 14, 1909.

CONSTRUCTION AND USE OF CRANES.

Cranes: their Construction, Mechanical Equipment, and Working. By Anton Böttcher. Translated and supplemented with English, American, and Continental Practice by A. Tolhausen. Pp. xvii+510. (London: A. Constable and Co., Ltd., 1908.) Price 42*s.* net.

MODERN developments of means of transit, especially in the direction of the transhipment of heavy goods, have made it necessary that rapid and powerful lifting gear should be devised, and *pari passu* with the developments of heavy engines and wagons, heavy ordnance and large ocean liners, there has been an equally interesting and important advance in the construction of rapid and heavy cranes.

The book before us has for one of its aims the presentation of the progress that has been made, and with this end in view many types of cranes are described and discussed in detail, and illustrated by photographic views of general arrangements, together with dimensioned drawings of more than seventy particular examples.

The book is, however, by no means simply a descriptive work, as all parts of cranes that lend themselves to theoretical treatment are dealt with in a sound manner. The first part of the book deals with first principles in crane-building practice, and to those who have had a preliminary training in the elements of applied mechanics should be of interest and of great value in showing their applications to definite design problems, as well as for the immediate object in view. For example, the use of the funicular polygon in the resolution and composition of forces is illustrated, and the laws of motion are used to determine the time of motion, and the forces required to give momentum to the travelling portions of various forms of cranes. It also includes an interesting paragraph on "efficiencies," and, along with other valuable tables, one giving the efficiencies of crane parts. In the paragraph on struts only Euler's formulæ are given. This is to be regretted, as it is generally agreed in this country that more trustworthy results are obtained by such formulæ as Rankine's or Tetmajer's. Part ii. is devoted to the general arrangements of cranes, and opens with a concise summary of the local influences which decide the character of cranes in different circumstances, followed by general descriptions of many types, from the old-time hand winches to the most modern electric-driven travelling cranes.

Part iii. deals with crane-driving principles; driving by hand, shafting, steam, water and electricity are treated, and the principles involved in the determination of the power required to lift a given load at a given speed, and the gear ratios are dealt with in detail. The subject-matter of the hydraulic and electrical sections is particularly good, but the translation is not all that could be desired, as the meaning is at times somewhat obscure, especially in the electrical section, which, we fear, will hardly be intelligible except to those very familiar with the theory and practice of motors. The translation is surely not happy when, in the hydraulic section, a sentence is rendered as "the rams beget larger diameters with equal lifts." In one or two cases the obscurity is intensified by slips in proof-reading, as, *e.g.*, on p. 102; the velocity of the water through the valve is proportional to the difference of pressure in the valve box and cylinder, so that in the formula, p_0 should be replaced by $p_0 - p_1$. We were some time before we could put a meaning to the following, which opens the paragraph on speeding up electric motors:—"The current curves represented in Fig. 257—corresponding with full cut-off initial resistance to the inscribed circumferential moment—are independent," &c., and even now we are in doubt as to the author's meaning. It is also, we think, not usual to speak of the back E.M.F. of a continuous-current motor causing current lagging. In the paragraph on "running down" we were rather held up for the moment by "To hold the load in a fixed position the simple running down will suffice in many cases," until we realised that the translator meant that the switch is in the running-down position, and the mechanical friction of the gearing, &c., is sufficient to prevent the load running down.

We do not remember in English works to have met with the method used by the author of determining the ratio of the areas of the lifting rams and the valve openings of hydraulic cranes, by consideration of the difference between the velocity of lifting and lowering. The method, though simple and well known to some English designers, has not received the attention it deserves, and is well worth careful study by those engaged in this branch of designing.

Part iv. considers in a very complete manner crane parts and accessories, and designers of all classes of machinery will find the information given valuable. This is followed by a section devoted to the design and calculation of crane girders. The designs of riveted joints and of various forms of girders are considered in a very practical manner, and where theory fails current practice is referred to. A number of sound hints are given, as, for example, when the author is dealing with the stiffening of travelling girders, he remarks:—

> "As practice alone can guide us in this respect, it is advisable, when such exigencies can be drawn upon to draft the design in such a manner that eventual stiffening may be resorted to if found to be requisite in testing or working."

The determination of the maximum stresses that can occur in the members of a lattice girder, due to the crab moving over the girders, is dealt with in a way that should appeal to those who are familiar only with the ordinary stress diagrams, the influence line being deduced from a number of diagrams drawn from a single load fixed at a different point for each of the diagrams. It is, we think, unfortunate that the very simple method of influence lines is not better known, as without the labour involved in drawing stress diagrams the unit load diagram or "influence line," for any member, in the top boom,

for example, can be at once drawn by erecting an ordinate at the junction of the diagonal of the same bay with the bottom boom, equal to the product of the two parts into which the junction point divides the span, and joining the end of the ordinate with the ends of the span. An equally simple construction gives the line for any member of the bottom boom, and the influence lines for all the diagonals can be drawn by first drawing two parallel lines through the ends of the span; then if verticals are drawn through the end points of any bay to meet these respective lines, and the two points of intersection are joined, the line thus drawn, together with the two parallel lines, is the "influence line" for the given bay.

Part vi. is devoted to the description of, and calculations for, types of German, English and American cranes. This part of the book is particularly valuable, as theory and practice supplement each other in a way that is really helpful to designers. The last three sections are devoted to specifications, useful tables, and a valuable index to articles and papers on cranes. The book is excellently printed and well illustrated on very stiff paper. It can cordially be recommended to designers, builders, and users of all kinds of lifting and carrying machinery, and we can hardly think of a branch of mechanical engineering in which the book will not prove useful for reference. Students will also be well repaid by a careful study of the designs given and the calculations therewith, as they will be able to appreciate, perhaps, better than in any other way, the limitations of the theories upon which they are apt to place implicit trust. F. C. L.

AN OXFORD CHAMPION OF DARWINISM.

Essays on Evolution, 1889–1907. By Prof. E. B. Poulton, F.R.S. Pp. xlviii+480. (Oxford: Clarendon Press, 1908.) Price 12*s*. net.

ON July 1, 1858, an epoch in the history of science was created by the reading, before the Linnean Society of London, of the papers by Darwin and Wallace on natural selection; and on July 1, 1908, the fiftieth anniversary of this momentous occasion was appropriately celebrated under the auspices of the same society. The publication of Prof. Poulton's volume is especially well timed, for it appears while the Darwin-Wallace commemoration is fresh in the minds of all, and while the weighty utterances by which the veterans Wallace and Hooker themselves so greatly added to the interest of the proceedings on that occasion are still a recent memory.

Among those men of science who have found their chief inspiration in the work of Darwin and Wallace, no one has laboured with greater perseverance and success than Prof. Poulton, and the present collection of essays embodies the main results of his investigations during his tenure of the Hope chair at Oxford. The memoirs have all in one form or another appeared before, but the author is not by any means content with a mere reprint of his former publications; he has, on the contrary, spared no pains to bring the treatment of his various topics up to date, and a comparison with the lectures and addresses in their original form will show that in many cases this must have involved considerable labour. But with so fertile and so rapidly growing a subject as that which Prof. Poulton has made his own, a period of nineteen years, which is that which separates the first essay in point of date from the present time, gives opportunity for enormous accessions of material, and almost inevitably involves some modification, if not in the principles, at least in the details of interpretation. The author has acted fairly towards his readers by ensuring that the essays here reprinted, though preserving the general form and tone in which they were originally framed, should nevertheless be the expression of his own present views, and should embody the principal points of evidence that have since come to light. The keynote of the book is the all-importance of natural selection, as propounded by Wallace and Darwin, in the interpretation of the past history and present condition of organic nature. The essays form a powerful reinforcement of what is properly and distinctively called the Darwinian theory of evolution, and should tend to reassure those weaker brethren who have allowed themselves to be persuaded or terrified into losing confidence in the work of the two great founders of rational evolutionary doctrine.

The greater number of Prof. Poulton's arguments and illustrations are naturally drawn from the wonderfully rich domain of insect bionomics. The way in which the great Oxford collection, so liberally established by Hope, and so assiduously tended by Westwood, has been made of late years to subserve the cause of scientific research and progress, especially in the unravelling of intricate problems of evolution, is one of the most remarkable features in the recent history of the University. The development of such studies in Oxford, of which the present volume is only one among many manifestations, should be a matter of cordial congratulation to the present Hope professor, on the part, not only of entomologists, but of all who take a rational interest in any department of biology.

Space would fail us in the attempt to give an adequate account of the contents of this stimulating book. A bare enumeration must suffice. First comes a discussion upon the age of the earth, comforting to those biologists who have been disturbed by certain physical calculations now in great measure abandoned. Next we have the question asked and answered, "What is a species?" Essays follow on the theories of evolution which rival or antagonise Darwin's, on the nature of heredity, and on the remarkable anticipation of Galton and Weismann by the anthropologist James Cowles Prichard. The Birmingham lecture on Huxley is of especial value, as it not only defines and accounts for the precise attitude of that great biologist towards the Darwinian theory, but also contains one of the most forcible and convincing pleas that we have yet seen for a more rational use in education of our present system of examinations. The three concluding essays, which show an immense command of facts, deal in a masterly manner with the fascinating subject of mimicry. They are especially remarkable as in-

dicating the gradual trend of opinion towards a large substitution of the Müllerian interpretation for that of Bates.

A word must be added on a subject of some delicacy. Prof. Poulton's introduction, in which he deals with certain of the assertions and pretensions of the English school of Mendelians, is undeniably controversial, and even in places personal. The author has in several quarters been taken to task for his polemics. This reminds us of the old complaint:—

> Cet animal est très méchant;
> Quand on l'attaque, il se défend!

Controversy is necessary for the progress of science. Personalities, we think, are, as a rule, better avoided; but there are cases when the tone adopted by the assailant makes it impossible to offer an effective resistance except by the employment of methods which would at ordinary times be left unused. Prof. Poulton shows that he warmly appreciates the interest and value of Mendel's discovery, and the keenness and industry with which it is being followed up, but we think that he is justified in his protest against an attitude necessarily tending to discourage the younger workers in a field which, since the ground was first broken by the great naturalists lately commemorated and honoured, has proved the most fertile of all within the wide realm of the sciences of life.

The book is fitly dedicated to Prof. Meldola, to whom all Darwinians owe an immense debt of gratitude. It is furnished with an admirable index, and both paper and printing are worthy of the traditions of the Clarendon Press.

F. A. D.

ARCHÆOLOGY IN GREECE.

The Annual of the British School at Athens. No. XIII., Session 1906–7. Pp. xi+488+plates. (London: Macmillan and Co., Ltd., n.d.) Price 25*s.* net.

In this volume of the "Annual" the director and students of the British School at Athens describe the excavations at Sparta during the year 1907. The work at the temple of Artemis Orthia was carried on very successfully, and the results are most important for our knowledge of Laconian art of the early period (eighth to sixth centuries B.C.). Taking all in all, the early Spartans seem to have been much more civilised than one would have expected; and if, as is supposed by Mr. Droop, the so-called Cyrenaic style of vase-painting is really Spartan, they seem to have been originative artists.

The temple of Athena of the Brazen House, where, as we read in all our Greek histories, the renegade victor of Platæa, Pausanias the king, was walled up and died miserably, has also been excavated, with interesting results. We do not note that any particular conclusions as to possible date of foundation, &c., are drawn from the orientation of these buildings.

The two most interesting articles other than these are the continuations of Mr. Dickins's very able critical article on the sculptor Damophon of Messene, and of Dr. Mackenzie's on Cretan Palaces. Dr. Mackenzie now completes his argument against Prof. Ridgeway on the one side and Prof. Doerpfeld on the other as to the precise signification of the great discoveries in Crete. He is doubtless right against Prof. Ridgeway in maintaining that the people who built the palaces of Knossos and Phaistos were not Indo-Europeans, and did not speak any kind of Greek, and against Doerpfeld in denying that they had any Achæan blood, or that their work shows any Achæan influence. In fact, the Achæan theory was knocked on the head by Prof. Ridgeway's trenchant criticism in his "Early Age of Greece," and Prof. Doerpfeld's Achæanised Carians have been knocked on the head by Dr. Mackenzie.

The "Minoans" may have been akin to the Carians, but not to the Achæans, who were Aryan Greeks, which the Carians, Lycians, and others were not. Where Prof. Ridgeway went wrong was in making his "Pelasgians" (=Minoans) Aryans. Whether the Minoans were Pelasgians or not we cannot say; Prof. J. L. Myres has lately shown how very useless for practical purposes this elusive ethnic name is. Prof. Ridgeway made the Pelasgi a pre-Achæan wave of Aryan invaders. But if so, they cannot have been the builders of the Cretan palaces, who came from the south, not from the north. Dr. Mackenzie makes them non-Aryan like the Minoans, but thinks that, driven from Greece by the Aryan Achæans, they fell back upon their Minoan kinsmen in the islands and Crete, and overthrew the Minoan culture, building amid the ruins of the labyrinthine Minoan palaces their own halls of the Mycenæan and Tirynthian type, which we have hitherto regarded as Achæan. Thus the Minoans would be pre-Pelasgic as well as pre-Achæan. Dr. Mackenzie regards the well-known "Warrior Vase" from Mycenæ as Achæan, no doubt correctly, and the geometric pottery of the Dipylon as Dorian, a view which, although it was generally accepted a few years ago, has its difficulties. Perhaps it was Achæan too. If it was Dorian, why is it found in Attica? Are we to suppose that the Athenians of set purpose deleted from their history the fact that their land had at one time been Dorized?

H. R. Hall.

SYLVESTER'S MATHEMATICAL PAPERS.

The Collected Mathematical Papers of James Joseph Sylvester. Vol. ii. (1854–73). Pp. xvi+732. (Cambridge: University Press, 1908.) Price 18*s.* net.

Among the 110 papers contained in this volume there are five or six which represent the author at his best. First of all there are three on Newton's rule for the discovery of imaginary roots of equations; here we see Sylvester working his way from a laborious and partly tentative method to the simple and beautiful proof which is reproduced in Todhunter's "Theory of Equations." (It is not impossible, by the bye, that there may be a series of cubic functions of the coefficients which would give information supplementary to that afforded by Newton's

series.) Then there are two papers on the motion of a rigid body containing a well-known addition to Poinsot's theory; these show admirably Sylvester's power of combining analytical and geometrical methods. Finally, there are the notes of his King's College lectures on the partition of numbers, which, in spite of their fragmentary form, supply some very interesting reading. They contain, practically, an outline of three distinct methods, that of combining a deficient set of linear equations, that of partial fractions, derived from Euler's generating function, and a barycentric method, or rather a barycentric way of stating the problem and its solution, especially with regard to its definite or indefinite character.

Among the numerous short notes there are many of permanent mathematical interest; for example, those on the twenty-seven lines of a cubic surface, on the involution of six lines in space, on the problem of the fifteen virgins, and so on. But, quite apart from their scientific importance, there is not one of these papers which is not entertaining or fails to illustrate the quaint personality of the author. His passion for coining new terms; his raids upon the Hebrew alphabet; his amusing accounts of the genesis of this or that theorem; such things raise a smile on the face of the reader. But the student of Sylvester's work who realises the power of his intellect and his thoroughly genial and magnanimous character, will end by adopting the attitude of the Eastern lover, who compares the mole on his mistress's cheek to a grain of musk or ambergris, which only enhances her charms.

Nearly at the end of the volume is reproduced Sylvester's presidential address to the British Association. This is memorable for the fact that in the course of it Sylvester scores a point against Huxley—a thing of which not many would be able to boast. Huxley, in an unguarded moment, had declared that mathematics was "that study which knows nothing of observation, nothing of induction, nothing of experiment, nothing of causation," an assertion which Sylvester triumphantly and conclusively shows to be anything but the truth. This address, and many of his occasional utterances, show Sylvester's intense conviction of the importance and dignity of mathematical science *per se*, a conviction that should be shared and expressed by every mathematician, for there is always a risk of the fact being forgotten and the science being neglected, or, still worse, patronised.

Finally, the appendix contains an amusing polemic between Sylvester, G. H. Lewes and others, on the metaphysical nature of space. Like most such controversies, it is nearly, if not quite, a mere logomachy, but it was worth reprinting on account of the eminence of the principal combatants.

The papers, as originally printed, swarm with clerical errors, so that Dr. Baker has no enviable task to perform as editor. To all appearance, the necessary corrections have been made in the most complete manner, and the printing of the text, with its complicated formulæ, and sometimes uncouth symbols, leaves nothing to be desired.

G. B. M.

A GEOGRAPHY OF RUSSIA.

Russland. By A. von Krassnow and A. Woeikow. *Länderkunde von Europa.* By A. Kirchhoff. Third Part. Pp. viii + 336; 18 plates, 21 figures. (Vienna: F. Tempsky; Leipzig: G. Freytag, 1907.) Price 22 marks.

THE growing use of the Russian language for scientific publication in Russia renders summaries of existing knowledge about that vast country increasingly necessary. We accordingly welcome this authoritative account of the geography of European Russia by Prof. von Krassnow, of Kharkhov, published in Kirchhoff's "Unser Wissen von der Erde," of which it forms the third volume of the series on Europe. The book labours under one serious disadvantage. It is printed in the old eye-straining German type, and readers who are careful of their eyesight will prefer works printed in characters that can be read with less fatigue.

The volume is closely printed, its information is detailed and concise, and it is illustrated by 18 maps and 21 other figures, all given as blocks in the text. The sketch-maps and sections are so useful that we can only regret that there are not more of them.

The geography of Russia has many problems of especial interest, as it is the most truly continental State in Europe, and is inseparably linked with Asia. It offers the most complete contrast available in Europe between typically continental conditions and those of the peninsulas of western Europe. Whereas England has one mile of coast line to twenty-seven square miles of land, Russia has only one mile of coast to every 260 square miles. Its climate marks clearly the effect of this continental character, and present knowledge of the climate of Russia is summarised in one of the most important chapters in the volume which is contributed by Prof. A. Woeikow.

The geography of Russia reflects in the wide range of its units the comparative simplicity of its geological structure. The constituent elements are developed on so great a scale that Russia exhibits the phenomena of marine transgressions with a clearness equalled in no other State of Europe. Ancient rocks are not very extensively developed, for so much of the country is deeply buried under drifts; but old rocks form the wide "Russian platform" of Suess in south-western Russia, and build up the long chain of the Urals. There is a valuable chapter on the geography of the Ural Mountains, which brings out clearly its essential structure as a dissected mountain chain with a meridional direction, formed by folding and followed by the displacement of earth-blocks. The population of Russia includes an interesting mixture of races; but it is, however, relatively small, numbering in European Russia less than fifty per square mile. Much of the country is sparsely occupied; of the whole area of European Russia only 26 per cent. is arable land, 19 per cent. is waste, and 39 per cent. is forest. So much of the land being unoccupied, it is not surprising that Russian cartography is backward, and in spite of the distinction of Russian geodesists we are told that the triangulation is incomplete for great parts of the country.

The work includes chapters on the biology and ethnology of Russia, as well as of the remarkable faunal history of the Black Sea; it gives a short but interesting discussion of the density of the population, illustrated by a map, which would have been more readily useful if the index of shading had given reference to another measurement as well as to square-versts. The book concludes with two long and instructive sections on the economic geography and on the towns which will be of great service to those who cannot use the detailed information in the forty-one volumes of the great Russian Encyclopædia (Entsikhlopeditcheski Slovar, 1890–1904).

LOCOMOTIVE ENGINEERING.

Locomotive Performance. By William F. M. Goss. Pp. xvi+439. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1907.) Price 21*s.* net.

The Railway Locomotive. What it is and why it is what it is. By Vaughan Pendred. Pp. xi+310. (London: A. Constable and Co., Ltd., 1908.) Price 6*s.* net.

PROF. GOSS and his assistants in the engineering laboratory of the Purdue University are to be congratulated on the very able manner in which they have carried out their researches on the performance of locomotives, and more particularly the experiments with the two locomotives installed in the locomotive testing plant at Purdue University.

The present volume is an account of the growth of the engineering laboratories at Purdue, the locomotive testing plant being more particularly dealt with, its inception being largely due to the interest taken by the late President Smart, of that university, in conjunction with the late A. J. Pitkin while general superintendent of the Schenectady Locomotive Works. In fact, the success of the laboratory appears to be largely due to the cooperation of the university authorities with the famous locomotive builders at Schenectady, many mechanical engineers being also interested in the success of the laboratory and rendering valuable assistance in many ways. As locomotive engineers, as a rule, base their designs on the result of practice and experience rather than on theoretical considerations, the contents of this volume must be of much interest to them, and we can strongly recommend its careful study.

The contents of the book are divided into five headings, the first four chapters dealing with "locomotive testing," under heading No. 1. These are most interesting, since the inception of the testing plant is described and the many difficulties discussed, the development of the laboratory largely increasing the interest taken by American locomotive engineers in the scientific treatment of the subject.

Chapter v. comes under heading No. 2, and gives a typical exhibit of the performance of a locomotive under varying conditions of speed and cut-off. Fig. 62 is an interesting illustration of the influence of speed on the indicator diagram when running with a late cut-off, making it very evident that both must be considered as having an important influence on the mean effective pressure.

Chapter vi. in part iii. deals with boiler performance, a most interesting subject. The question of locomotive boiler design has come prominently to the front in recent years, and much attention has been given to it. The human factor, however, in the form of the fireman, enters very largely into the question, a fact which our author very carefully points out. Another most important detail of locomotive design is dealt with in chapter xi.; we refer to the smoke-box, or front end, since the efficiency of the engine is very largely due to the correct proportions and arrangement of the blast-pipe and chimney. The arrangement of these details is thoroughly discussed, and the best proportions expressed in simple equations.

Part iv. of the book deals very largely with cylinders, valve gear, and the all-important question of correct balancing. Prof. Goss is to be congratulated on the able way in which he has handled the latter subject; his experimental work as described in chapter xviii. is most valuable, and has added considerably to our knowledge.

Locomotive performance is discussed in part v. of this interesting book, the last chapter of which generalises the many points discussed. Taken as a whole the volume is quite unique; it contains valuable information of a highly scientific nature, and we strongly recommend all interested in locomotive engineering to study it.

"The Railway Locomotive," by Mr. Vaughan Pendred, is a book very different from Prof. Goss's; it is one of the Westminster Series, and we are told that it is intended to bridge over the gaps left by specialisation. What this means is not quite clear; but if it is the intention of our author to describe the locomotive as it is for the benefit of engineers not of the locomotive variety, then he is to be congratulated upon having produced an interesting and useful volume, and one likely to fulfil the object he has in view.

The book is divided into three sections. The locomotive as a vehicle is first treated, and occupies nine chapters, the eighth of which deals with adhesion, and we are pleased to notice that the late Mr. Patrick Stirling's famous "singles" are quoted and referred to as highly successful engines. They will be remembered when many modern monstrosities have gone to the scrap-heap and been forgotten.

Section ii. deals with the boiler, the sectional diagram of which, Fig. 39, is certainly not modern. The author has much to say, naturally, about staying flat surfaces, and the differences in the coefficients of expansion of the copper fire-boxes in the steel shells of locomotive boilers. He here deals with the biggest worries of the locomotive engineer. Locomotive boilers have increased in dimensions in an abnormal manner, and, unfortunately, the bigger the boiler the bigger the wear and tear. Stay bolts are dealt with in chapter xii., and, passing over what the author has to say about Captain Palliser and armour plating, which has nothing to do with the case, we learn that various bronzes have been tried, as well as

Bowling and Low Moor iron. Copper is, of course, the universal practice for stay bolts when a copper fire-box is used. A copper stay bolt screwed into a copper plate with its head carefully riveted over is more likely to stand the wear and tear, since the coefficient of expansion is the same. Leakage at the joints is reduced to a minimum; the action of the fire on the riveted head is far less severe, thus ensuring a far longer life than if the stay was made of a bronze, which naturally wastes with the fire action, the head vanishing, and later on the shank of the stay bolt in the copper plate for the same reason unless replaced in time. Fig. 44 is a good illustration of this wear and tear, although it is probably intended to illustrate a badly worn copper stay many years old.

Given a wider water space, and a pitch of stay bolts less than the usual practice, then with the high pressures now in use no trouble need be anticipated from broken stays, and copper is evidently the proper material to use, since it has to be fitted into a copper plate and both exposed to intense heat.

On the general design of boilers we find much useful information, and reference is made to Mr. Drummond's water-tube fire-box; surely the late Mr. W. M. Smith, of the North-Eastern Railway, had a good deal to do with the arrangement of the water tube, it being originally fitted into the fire-box of North-Eastern Railway engine No. 1619 in a somewhat similar fashion. This engine is not mentioned, by the way, in chapter xxxiii., dealing with compound locomotives, although it is the progenitor of the Smith type of three-cylinder compounds on the Midland and Great Central Railways; that is to say, the engine is fitted with one high-pressure and two low-pressure cylinders, the latter being used as high-pressure cylinders and the former being in equilibrium when starting a heavy train automatically. It is, of course, well known that the three-cylinder Smith compounds on the Midland have been fitted with a special regulator valve, which does away with the Smith automatic valve.

The question of compound working of locomotives has been a prominent one for a long time, and we cannot congratulate the author on the way in which he has dealt with it; surely four pages in a book of 300 pages is a ridiculous proportion to give us in a work on the railway locomotive. All engineers are fully aware that Mr. T. W. Worsdell was the inventor of the two-cylinder compound locomotive; why Mr. James Worsdell should get the credit is a mystery. This is a careless mistake for which there is no excuse.

On the question of valve gear, expansion and link motion, we find much information, but why "James Stirling's" steam reversing gear is described as "Wainwright's" might be explained; besides this, the latest type of the Smith piston valve is not illustrated in Fig. 81. It is of the segmented type, and is intended to free the cylinder of water when necessary, being collapsible. The vacuum-destroying valve referred to has also been re-designed so far as to constitute a lubricator as well, thus lubricating the moving parts when running down hill with steam off, a much desired improvement.

We have much pleasure in noticing these two books; they have been written from such different points of view that one forms the corollary of the other. Locomotive engineers will do well to find a place for both in their libraries.

OUR BOOK SHELF.

Feste Lösungen und Isomorphismus. By Dr. Giuseppe Bruni. Pp. vi+130. (Leipzig: Akademische Verlagsgesellschaft, 1908.) Price 4 marks.

As an authority on the subject of solid solutions Dr. Bruni has an international reputation, and it must be considered a fortunate circumstance that the Chemical Society of Breslau should have invited the author to give a special lecture to its members, for it is to that incident that the book before us owes its origin.

The theory of solid solutions put forward by van 't Hoff in 1890 represents an extension of his well-known theory of liquid solutions to the solid state of aggregation. As a means of interpreting the vast number of experimental observations which have been accumulated since the date of its conception, van 't Hoff's theory has been invaluable. The author is one of its staunchest adherents, and has himself done much to uphold the theory in the face of adverse criticism.

Dr. Bruni has retained the original form of the address in the published text. The subject-matter of the lecture, which occupies eighty pages, is divided into two sections; the first deals with the mode of formation and the nature of solid solutions, the second with the connection between the crystalline form and the constitution of pairs of substances which give rise to solid solutions. Explanatory notes, experimental data relating to the observations referred to in the first part of the text, and references to original papers which are in many cases accompanied by critical abstracts, occupy the remaining fifty pages. The arrangement is a most satisfactory one, and the many references afford an excellent bibliography of the subject.

Not more than ten years ago a solid solution was regarded as somewhat in the nature of a *rara avis.* The investigations of Roozeboom, Tammann, Kurnakow, Bruni, Carelli and others have, however, necessitated a complete change in the attitude of the chemist towards the conception. As showing the general character of the phenomenon, the fact may be cited that of one hundred and forty pairs of elements examined by Tammann and his pupils, no less than seventy-seven give rise to solid solutions, and in twenty-three cases mixed crystals are formed which contain the constituent elements in all possible proportions.

Most interesting is the author's account of the application of the observed facts relating to the formation of solid solutions to the determination of the configuration of organic compounds. That much valuable information may be obtained from observations on syn-morphism (ability to form mixed crystals) in connection with the solution of certain stereochemical problems is clearly indicated. It is, however, not only on account of its applications, but of the intrinsic interest which attaches to the phenomenon that Prof. Bruni's lucid exposition of the subject of solid solutions and isomorphism may be expected to meet with a favourable reception by a wide circle of readers. Not merely the chemist, but the physicist, mineralogist, and geologist will find much that bears on his particular subject in this little volume.

H. M. D.

The Economic Open-air Chalet for the Hygienic Treatment of Consumption and other Diseases. By R. Foster Owen. Pp. 16 (London: Baillière, Tindall and Cox, 1908.) Price 1s. net.

MUCH attention has of late been bestowed on the open-air treatment of consumption and other tuberculous diseases, but residence in sanatoriums is expensive and only possible for the well-to-do, and the provision of shelters and homes suitable for the poor is deserving of much consideration. The booklet under review describes the construction of a cheap shelter, and the author claims that by the enlargement and multiplication of such shelters, colonies for the tuberculous poor could be founded at comparatively small cost.

The chalet described is constructed wholly of wood, is elevated 3 feet above the ground, and built upon piles of wood. If considered desirable the supports may be of brick with a foundation of old pitch and tar. The superstructure is surrounded by a veranda and approached by a flight of steps of wood. The veranda is of sufficient width to admit of a chair or lounge for the patients to sit or lie out in any weather, and is protected by a sloping, overhanging roof, which covers the whole veranda. The walls are permanently open in panels, chin height (as a rough measure), and fitted with a simple mechanism allowing of the erection of panel shutters should it at any time be found necessary. In case of severe wind, rain, snow, or of intense cold, this provision may be of service. It will, of course, only be used as the doctor-in-charge shall direct, for it must be remembered that the poor have to be taught to overcome their innate dislike to fresh air, which is only too frequently misnamed draught.

The interior of the economic chalet is divided into cubicles, with an ante-room for lavatory purposes. For patients of the working class an open ward is best, with separate washing-room and lavatory. The corners of the chalet are rounded off, and the walls perfectly smooth and washable. The roof is provided with two large dormer windows for the admission of light, at each side of chalet. The author will be pleased to supply particulars as to cost, &c.

R. T. H.

Welt-Leben-Seele. Ein System der Natürphilosophie in gemeinfasslicher Darstellung. By Max Kassowitz. Pp. iv+364. (Vienna: Verlag von Moritz Perles, 1908.) Price 5 Kr.

THE author tells us in the preface that he has devoted his intervals of rest during a ten months' tour through the most beautiful countries of Europe to the production of a popular exposition of the three tremendous subjects the names of which form the title of his book. This information puts the critic at an obvious disadvantage, for he is tempted to view indulgently, and as merely the natural efflorescence of holiday spirits, the reckless demolition of respectable opinions and the amazing logical feats that characterise Dr. Kassowitz's progress through his theme. But the reader (like Quintilian) can only stare and gasp when he finds, on the seventh page from the end, that the author regards his work as an attempt to purge the scientific interpretation of nature from the "metaphysical" elements that at present clog it. It is true that by the avoidance of metaphysics he means something quite different from a restriction to positive statements about the actually observed course of phenomena, for he does not feel himself debarred from deciding on *a priori* grounds such questions as the infinite divisibility of matter and the inheritance of acquired characters.

His cardinal maxim is that an assumption or hypothesis is not to be entertained if it is not "analogous to experience," and it leads him to such arguments as the following. We never find motion apart from matter; consequently, if motion has passed over from one thing to another it must have been carried by moving matter. Again, since we know no homogeneous continuous substance, there can be none; therefore the transference of motion, even through the æther, must (from the foregoing proposition) involve the agency of an infinite series of atoms of increasingly higher order. Once more, there can be no natural selection, for this would imply somewhere a supernatural knowledge of the future usefulness of the selected variation. One would have thought that the glare of the fallacies involved in these arguments would have shone even through the delicious obfuscation of a walking tour.

Abhandlungen uber theoretische Physik. By Prof. H. A. Lorentz. Vol. i., part i., pp. 298. Price 10 marks. Part ii., pp. 299–490. Price 6 marks. (Leipzig: B. G. Teubner, 1906–7.)

ON December 11, 1900, Prof. Lorentz celebrated the twenty-fifth anniversary of his doctorate. His physical researches thus extend over rather more than a quarter of a century. In editing them for publication, Prof. Lorentz has aimed at bringing them into the form of a connected series, and a great many modifications and alterations have been made with the view of rendering the collection more useful in the light of recent developments. A number of papers of minor importance have been omitted and changes of notation have been freely made; instead of adopting a chronological order, the author has classified his papers according to subject-matter, and several new and hitherto unpublished results now find their way into print for the first time.

Vol. i. is divided into two parts, the first dealing with dynamics, hydrodynamics, thermodynamics, and kinetic theory—in short, molecular physics; the second with crystallography and physical optics. The following papers are now published for the first time:—Regions in n dimensional space (1905) (p. 151); the second law and its relation to molecular theory; symmetry of crystals; boundaries of crystals (all three based on Prof. Lorentz's lectures); propagation of light in an arbitrarily moving medium (not previously published); propagation of waves as rays in a non-absorbing medium (1906). The papers are now printed in the language in which they were originally published. As Prof. Lorentz points out, Dutch physicists find it necessary to publish their papers in one of the three principal international languages, and Prof. Lorentz did not consider it necessary to translate all the papers into one common language. G. H. B.

The Wonderful House that Jack Has. A Reader in Practical Physiology and Hygiene. For use in School and Home. By Columbus N. Millard. Pp. xiii+359. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.) Price 3s.

THIS well-printed, well-bound, and well-arranged book adds yet another to the long list of popular physiologies. The author endeavours to convey, without difficult technicalities, all the main points of the physiology of the body—the building of it up from food materials, digestion, the stomach, milk, animal foods, food habits, breathing habits, stimulus, clothing, eyesight, hearing, rest and sleep, infectious diseases, &c. The expositions are very simple and attractive. There are many illustrations. Each chapter has a set of questions appended, and there is a glossary of terms, obviously meant for the most elementary pupils. The book may be thoroughly recommended as a good class book.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Sequestrated Church Property.

A WIDELY spread feeling exists, especially among Roman Catholics, that sequestrated church property carries a curse with it; that the effect of the curse is to extinguish the line of descent from its owner, and to fall most heavily on the eldest son. A lady was so much impressed with what had been told her and with the evidences adduced as to the reality of the curse, that she asked me to help in investigating the matter. It had other interesting aspects, so I consented to frame an appropriate *questionnaire* for starting the inquiry on proper statistical lines. This was printed, and 245 copies of it were filled up by a well-known antiquarian, the Rev. Harvey Bloom, of Whitchurch, near Stratford-on-Avon, in the order in which they happened to be entered in the works of reference that he used. Their contents were then discussed by Mr. Edgar Schuster, fellow of New College, Oxford, and formerly research fellow of the eugenics laboratory in University College, London. Finally, such of the results as seemed most appropriate are given here. Mr. Schuster's report was elaborate; it ought (as he wrote when he sent it) to be checked as regards minute particulars if published in full, but he is quite content that the broad results given in the present paper should go forth as they stand.

The questions referred to the owner of each of the 245 properties in 1800 and to its owner at the present time, or at the latest date at which information was easily accessible; also to each of the intermediate owners in succession.

The phrase "Church property" applies to such properties as were ecclesiastic, wholly or in part, previous to the dissolution of monasteries under Henry VIII., and "Not church property" to those that were not so.

The results are as follow:—

SURVIVAL OF ELDEST SONS.

	Total number of owners	Of eldest sons among them	per cent.
Not Church Property	459	241	52·5
Church Property	464	240	51·7

LENGTH OF TENURE (EXCLUDING FIRST AND LAST ON THE LIST [1]).

	Mean length	Median length
Not Church Property	27·2 years	Between 25 and 26 years
Church Property	27·4 ,,	,, ,, ,,

Calculations were also made of the mean relative frequency of tenures in each of the eight groups:—0–9 years; 10–19; . . . 70–79 years. The lines in a diagram constructed from these ran closely alike, quite as closely as could be expected from the eight-times reduced sizes of the samples from which these means were derived. We may therefore rest satisfied that no appreciable effect is exerted by a curse supposed to thwart the inheritance of church property by eldest sons, or to shorten the tenure of its ownership.

A curious anomaly is, however, formed in the more than three-fold greater frequency with which church properties come into the market as compared with non-church properties. The facts are given in the following table:—

	Total of owners	Total of transmissions by purchase	Percentage of transmission by purchase
Not Church Property...	459	15	3·3
Church Property...	464	50	10·8

The answers to the *questionnaire* do not give sufficient material for minute examination into the reasons why church property is sold with this remarkable frequency, notwithstanding what has just been established concerning the length of its tenure. It would require a fresh and more delicate investigation to explain it. For the present, I am inclined to ascribe the anomaly to the comparative unsuitability to modern requirements of the dwelling houses, such as abbeys, &c., which frequently accompany church properties. They are nearly always built in low situations, near to fish ponds, and with bad drainage. They are therefore insalubrious, while the arrangement of the apartments is usually inconvenient in many important respects, and very costly to modify. On the other hand, the picturesqueness and romance of old buildings adds much to their market value. So it might be expected that when one of them falls into the possession of a distant relation, who has no very close associations with the place, who knows its discomforts, and probably has a residence of his own, he would be glad to sell. This is a pure speculation, but helps to show that the contents of the above table are not so provocative of a mysterious interpretation as they might otherwise be.

FRANCIS GALTON.

[1] These are excluded—the first, because the data did not give the commencement of the tenure; the last, because the owner was still living, and therefore the future close of his tenure was unknown.

The Isothermal Layer of the Atmosphere.

APART from other considerations, I think that Mr. Craig's contention (NATURE, January 7, p. 281) as to the isothermal layer is disproved by the results of theodolite observations on *ballons-sondes*. When a balloon is observed, its altitude above the horizon is in general seen to decrease, showing an increase of wind velocity with height. If Mr. Craig's supposition were true, this decrease in apparent altitude would become still more marked when the balloon had reached such a height that it no longer ascended; but the contrary is the case. In nearly all the ascents in which I have observed balloons for a considerable time the angular altitude, after decreasing, commences to increase again; on Mr. Craig's supposition this would mean that the balloon, after it reaches the floating condition, enters a current of air that brings it nearer to the observer, and for this to occur frequently is extremely unlikely.

Two instances will illustrate this point. A balloon on October 1 last year was watched until it burst; the meteorograph gave a height of 19 kilometres, with the isothermal layer at 12·2 kilometres. If the balloon had ceased to rise at 12·2 kilometres the observed altitudes show that it would have been moving towards the observer at the rate of 25 kilometres an hour during the six minutes previous to bursting, whereas before this it would have been moving away at the rate of about 70 kilometres an hour. At the time it burst it would have been 46 kilometres away, and it fell 104 kilometres from the starting point; the balloon was unlikely to travel further during the descent than during the ascent.

In the ascent of October 2 the balloon was also seen to burst; the height from the meteorograph was 17 kilometres, with the isothermal layer at 14·6 kilometres; if the balloon had ceased to rise at 14·6 kilometres it would have been moving towards the observer at the rate of about 9 kilometres per hour during the seven minutes before bursting, while previously it would have been moving away at the rate of about 50 kilometres per hour. If either balloon had reached a floating condition, it is difficult to see why it should have burst; it would probably have floated until loss of gas caused it gradually to descend. I think it is quite evident that on these two occasions the balloon was ascending up to the time of bursting, and both traces show the isothermal condition. If it is assumed that the height as given by the meteorograph trace is fairly accurate, the increase in angular altitude at the end of the ascent would show that the balloon had entered a layer of the atmosphere where the wind velocity had decreased considerably, which is exactly what one would expect to find in the isothermal layer.

In reference to Mr. Craig's supposition that the gas inside the balloon may be sluggish in acquiring the low temperature of the air into which it rises, it seems probable that the gas inside the balloon will tend to be at a lower temperature than the air outside, for the gas inside will tend to cool at about the adiabatic rate for dry air, while the rate of decrease of temperature of the air up to 12 kilometres or so is nearer the adiabatic rate for saturated air.

CHARLES J. P. CAVE.

Ditcham Park, Petersfield.

Magnesium in Water and Rocks.

THE recent publication of analyses of salt in the pans in Cape Colony by Dr. Juritz (*Agricultural Journal*, November, 1908, Cape Town) brings to a head a problem which has been puzzling me for a long time. A large amount of magnesia is dissolved in water on the decay of rocks, yet a very small portion finds its way to the sea. Dead coral reefs become dolomitised, but, as a general rule, recent limestone deposits do not contain more than 1 per cent. of magnesia; the magnesia dissolved in sea-water, therefore, is the accumulation of long ages, and should bear some relation in quantity to that of sodium, yet magnesium in the salts of sea-water is less than one-twelfth that of sodium. In the up-country pans in Cape Colony which collect the water washing over dolerite hills and evaporate the contents on their shallow surfaces, we find plenty of magnesia in the liquors, but practically none in the crystallised product. Here are Dr. Juritz's figures for an average sample:—

Locality	Water, grains per gallon	Salt, per cent.	
Varsch Vley	1204·0 ...	2·13 ...	Lime sulphate
(Ground salt)	Nil ...	Nil ...	Lime chloride
	553·0 ...	0·33 ...	Magnesium sulphate
	658·0 ...	1·16 ...	Magnesium chloride
	Nil ...	Nil ...	Sodium sulphate
	22050·0 ...	96·43 ...	Sodium chloride
	70·0 ...	Nil ...	Potassium chloride

Of the seventy-three samples of salt analysed, all tell the same tale; one from Belmont Salt Pan, near Kimberley, contains 7·59 per cent. magnesium sulphate, two contain more than 1·5 per cent., and the rest 1·5 per cent. or under. The ground water, however, struck in wells, is often entirely undrinkable with Epsom salts.

Magnesia compounds, on the other hand, are constantly being drawn down in the earth's crust by the descending surface waters, and cause dolomitisation. The older the limestone, generally speaking, the more it is dolomitised; joints and bedding planes in limestone are dolomitised when the rest is pure limestone, as in the "dunstone" selvages along joints in the Carboniferous Limestone of Durham and Northumberland. Why do the magnesia compounds go downwards and not outwards as the salts of lime and soda do?

The same happens with solutions of iron; practically none reaches the sea, but large amounts descend and replace limestone by spathic iron or hæmatite. In this case one would conclude that the earth's magnetic nucleus exerted a pull on the free iron in solution, which, ceaselessly acting, tended to impoverish the surface of iron. Is there some such action going on with regard to magnesia? Taking Farrington's suggestion that the average composition of meteorites represents the average composition of the earth, then the nucleus should contain a very large proportion of magnesium. Is there any evidence for an attraction of magnesium for magnesium when magnetised as there is in the case of iron for iron?

ERNEST H. L. SCHWARZ.

Rhodes University College, Grahamstown, Cape of Good Hope, December 21, 1908.

Phosphorescence on a Scottish Loch.

A REMARKABLE illumination was observed about eight years ago on a certain part of Loch Bulig (which lies in the north-western boundary of Aberdeenshire). As it appears to be the only known occurrence of phosphorescence on a Scottish loch, your readers may be interested in it. It appeared in the form of innumerable brilliant lights, shooting rapidly on the surface of the water, but many leaping one or two feet above it. It lasted for about a minute, and was repeated twice at intervals of about ten minutes. The effect was very striking, the brilliance being almost dazzling. It seemed that it could not be accounted for in any other way than by phosphorescent animalculæ, disturbed probably by a shoal of fish which are known to inhabit the loch.

Inquiry elicited the information that near where the lights were seen a soft bank stretched out from the side towards the centre of the loch. I have been desirous since that time to gather some of the deposit, if possible, for examination, but only a few months ago was I able to carry out my intention. I found it was a matter of no little difficulty, as the loch at that part is about 25 feet deep, and though it is usually quite smooth it sometimes is somewhat rough. The first attempt was a failure, the day being squally, the waves 2 or 3 feet high, and the strong wind and current rendered it difficult to locate the bank and collect specimens. The second attempt, however, was successful, and I found that the bottom was generally stony, but gave place to soft material just above where the lights had been seen. I collected two quantities of the deposit, and found that it consisted of sand mixed with a large quantity of carbonaceous matter, mostly in the form of small rolls, half an inch to one inch long. Microscopic examination showed that these rolls contained animals encased like tubicolous annelids; they were quite active, emerging from the tube, grasping black particles, and then retreating; some were encased in parchment-like tubes, through which the rapid actions of the animal could be distinctly seen; one was found with a transparent tunic, hanging by a ring from the neck, resembling *Oxyethira costalis* (Hydrophilideæ); I still have this specimen. Along with these and other animals were numerous diatoms, nematodes, &c. As some of these animals belong to classes which are known to be phosphorescent, it seems that their presence in the deposit is sufficient to account for the remarkable appearance seen. This was confirmed by finding that the sand contained much more phosphate than sand usually contains; also, by testing with ammonium molybdate some of the black matter, including one of the black rolls containing an animal, after a few hours a distinct yellow precipitate was found, but only in the vicinity of the black roll.

I should think that this deposit would form an interesting preserve for zoologists, and therefore I relate the circumstance, and shall be glad to give any further information to anyone who may desire it.

THOS. JAMIESON.

Chemical Laboratory, 10 Belmont Street, Aberdeen.

[IT is to be hoped that Mr. Jamieson will re-observe the interesting phenomenon he saw on Loch Bulig and collect material *at the time*. If he saw numerous luminescent organisms leaping in the air, they may ***possibly*** have been Chironomids with phosphorescent bacteria. He gives no convincing evidence in his letter that the organisms collected from the deposit were connected with the "phosphorescent" display. We may recall the fact that a "phosphorescent" Enchytræid has been reported in Britain.—ED. NATURE.]

The Movement of Water in Soils.

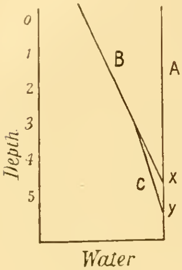
IN NATURE of August 6, 1908, Dr. Russell refers, in his note on *soil moisture*, to some information on this subject which I published in Memoir No. 6 (Chemical Series) of the Department of Agriculture in India, and says, "Dr. Leather argues that water moves upwards from a limited depth only. . . . The results are equally well explained on the supposition that the upward movement takes place at all depths, since the amount of water present in a particular layer depends on the respective rates at which water is gained from below and lost to the upper layers."

I still maintain that the process of upward movement of water through a soil during dry weather is one which is not brought into operation throughout all strata of a soil instantaneously, but that, on the contrary, time is required for it to be communicated through succeeding strata; consequently, during a dry period there will be strata in which the process has not yet become established. Until an alteration of the surface tension occurs in any stratum there can be no movement (due to this cause) of water, and a *necessary* result of the fact that this alteration of surface tension through succeeding strata is *gradual* is that any such alteration *must* be accompanied by a decrease of water per cubic foot.

A second consequence is that if the total decrease of water which occurs during a dry period throughout the

strata is ascertained, this will be precisely that quantity of water which has evaporated from the surface of the land.

The only weakness that I have been able to perceive in the conclusions which I drew in 1907 regarding this matter is the exact depth which was affected. This I concluded to be 7 feet in the Pusa soil. As a matter of fact, the ascertainment of this depth with exactitude is not possible. In the marginally shown diagram are three curves. A represents the water immediately after rain ceases (in an ideal physically uniform soil). B represents the water as ascertained at the conclusion of the dry period, and cuts A at the point x, below which no decrease of water has been perceptible by the methods employed. Owing, however, to errors, due principally to difference of physical character of soil, this point cannot be determined exactly, and in reality the curve might be BC, that is, it might cut A at, say, y, and not at x; but the difference between the ascertained loss and the real loss can only be trifling. It is perhaps needless to add that this error does not affect the principles involved. It is naturally assumed that the points x and y are above the stratum of soil which is maintained in a saturated condition by the underground water.



J. WALTER LEATHER.

Pusa, Bengal, November 23, 1908.

DR. LEATHER is no doubt correct in supposing that the upward movement of water through the soil is gradual, and in his further deduction that there must, for a time, be some strata in which the water has not yet begun to move; but we do not know the velocity at which water travels upwards in the soil, and consequently one cannot say whether the time during which any particular stratum remains unaffected is to be measured in days or months. Dr. Leather's results do not give the velocity of upward movement, but the difference between the loss and the gain of water at different depths. It is no more possible to calculate the amount of water that has passed through a particular stratum by determining the amounts present at two different times than it would be to calculate the quantity of heat passing along a rod of unknown thermal properties by measuring the temperature change at a particular point.

The great value of Dr. Leather's results lies in the fact that they are the most complete set of moisture determinations yet made under conditions of drought. If only some physicist could be induced to turn his attention to soil problems he would find these *data* very useful.

E. J. RUSSELL.

The Rothamsted Laboratories, Harpenden, Herts.

The Correlation of Teaching.

THE valuable summary of Prof. Perry's address to the "correlation" conference given in NATURE of December 3, 1908 (p. 143), contains the following statement:—"If a boy wrote a description of anything he had done in a laboratory or elsewhere, it should be an exercise in English." This is, *unfortunately*, accepted by educationists at the present time. Can Prof. Perry not aid in breaking down this barrier to progress rather than in fixing its joints more firmly? He has done so much, cannot he do more?

I would suggest, whether in class-room exercises or in examinations, that the boy's resultant essay should be examined and corrected by the examiner without reference to spelling, writing, grammar, &c. The object should surely be to put on paper what has been learnt about the subject in hand. Spelling being the result of the use of accurate vision, writing being the result of physical and nervous stability, need in no circumstances affect the value of a scientific production. As the boy gets older and as his view of life extends, the value of his production, from the point of view of English, will gradually improve.

Besides, it is nothing short of an absurdity to look at certain exercise books, where the red-ink corrections, that have taken so much of the teacher's time, are chiefly connected with something that in no way affects the value of the exercise itself.

CHARLIE WOODS.

December 31, 1908.

I AGREE with Mr. Woods in his condemnation of a system in which every exercise is treated as if grammar and composition were as important as the subject-matter; but surely he is going too far when he says that in writing a description of what he has done or seen, a boy need not fear that his grammar or spelling or composition will be criticised at all. I ask the science master, in teaching science, to teach also mathematics and English and sketching incidentally, and to take some pleasure in doing it. If he insists that these subjects are the absolute preserves of the mathematical, the English, and the drawing masters, he must not be astonished when a classical master openly expresses pride in an ignorance of "stinks."

I do not think that the system which Mr. Woods condemns is very much in vogue, whereas the system of which he approves has done an immense amount of harm. We all of us know men holding the highest science degrees whose spelling, grammar, and composition are beneath the contempt of a board-school boy. In nine cases out of ten it will be found that when a student cannot give a clear account of what he has seen or done, he has no clear ideas about the matter, and every examiner knows that it is only the very exceptional man who has clear knowledge yet cannot express himself clearly. If the examiner has a keen sense of justice this candidate gives him more trouble than any five others.

JOHN PERRY.

An Electromagnetic Problem.

THE problem noticed by Mr. Comstock in NATURE of November 19, 1908, is an interesting one, but I do not see how the "laws of electricity and conservation of energy require in themselves the discrete structure of electricity or the association of electricity with matter." The electromagnetic field produced by a uniform spherical sheet of electricity, unassociated with matter expanding under its own repulsion, is not zero, but indeterminate. The total energy of the system remains finite and constant, while the velocity of expansion is that of light. Thus perfect uniformity of electricity, together with isolation, is not incompatible with the laws of electricity and conservation of energy. The indeterminateness of the electromagnetic field will, of course, surprise no one who is willing to start with a distribution of electricity differing infinitely little from that of perfect uniformity, arranged as a sheet differing infinitely little from spherical, and expanding in surroundings departing infinitely little from the symmetrical.

A. CORE.

MR. CORE's objection would apply in many problems where certain functions appear to vanish because of symmetry, but in the present case I think it does not apply.

In physical problems it is well to avoid mathematical "sheets" except in unusually simple circumstances, and in the present case the spherical shell of electricity which is expanding under the mutual repulsion of its parts is to be considered of *finite thickness* and of constant volume density of electricity.

In these circumstances the displacement current is evidently equal and opposite to the convection current when the sphere is expanding, and hence the curl of the magnetic force is zero everywhere. This requires the magnetic force to be zero everywhere, since such a vector vanishing at infinity and having its curl and divergence both zero must itself vanish. It is not then immediately evident what becomes of the electrical energy lost on expansion.

D. F. COMSTOCK.

Institute of Technology, Boston, December 17, 1908.

THE ANTHROPOLOGY OF THE GREENLAND ESKIMO.[1]

THIS work deals in a very thorough fashion with the psychology and culture of the three distinct branches of the Eskimos which make up the population of Greenland, namely, the West Greenlanders, the East Greenlanders and the Polar Eskimos. The book is splendidly illustrated by Count Harald Moltke.

The greater part of the book is devoted to a description of the Polar Eskimos, who live on the strip of land north of Cape York, and are the most northerly people in the world. Mr. Rasmussen, who was born in Greenland, appears to have thoroughly understood the people and how to gain their confidence. The consequence is that during his ten months' residence among them he has been able to collect a vast amount of interesting information about their daily life, their beliefs about the origin of the universe, and their fables and legends.

Even the Polar Eskimos, though the least advanced of the three groups of Greenlanders, appear to have progressed well beyond the stage of primitive savagery; they have fully entered the magical stage and to some extent passed into the supernatural. The magician is a man of mighty power amongst them. Their religious beliefs consist of a series of commandments and rules of conduct controlling their relations with unknown forces hostile to man. The magician makes these powers subservient to himself. He has developed his faculties so that he can put himself in communication with the spirits. He uses a special spirit language in his incantations. Magic is said, however, to be degenerating among these Eskimos, because they are not nowadays much exposed to danger.

Some of their beliefs that have apparently been handed down by oral tradition through untold generations are by no means primitive, and have a remarkable resemblance to the beliefs of some peoples in a much more advanced stage of civilisation. The Polar Eskimo believes that every person has a soul, a body and a name. He believes that the soul is immortal, that when the soul leaves the body the body dies, and that on the death of the body the soul ascends into heaven. It is believed that the soul of a man, on his death, may pass into one of the lower animals; the doctrine of the transmigration of souls appears, in fact, to be fully developed among the Eskimos.

The body of the Eskimo at death is buried by his relatives along with all his implements, and his dogs are slain harnessed to a sledge which is placed by his grave. For a woman only one dog is slain.

The name was originally believed by the Eskimo to be a kind of soul, which transferred the qualities of a dead person to the living person who received the name.

As regards the personal character of the Polar Eskimo, he appears to take a very practical view of life. The boys learn the main business of life, namely, hunting, in their play, and abstract reflection appears to be unknown. They are very fond of their dogs; one has been known to attack a bear at great personal risk in order to avenge the death of a favourite dog.

Polygamy is rare among them, but there survives a curious custom of exchanging wives which appears to have the full sanction of public opinion.

A very complete collection of the fables and legends of this interesting people will be found in Mr. Rasmussen's volume. These were all collected from the natives by the author, and great care, apparently, was taken to get the correct versions. This material will be invaluable to the folklorists. But whether they will be of much value, as suggested by Mr. Herring, in tracing the racial origin of the people is doubtful, for very close analogies to some of these tales will be found in the lore of the most distant parts of the earth. For example, the tale of the man who married the goose by stealing her coat of feathers, which she had laid off while bathing, is paralleled by a very similar tale in the "Arabian Nights."

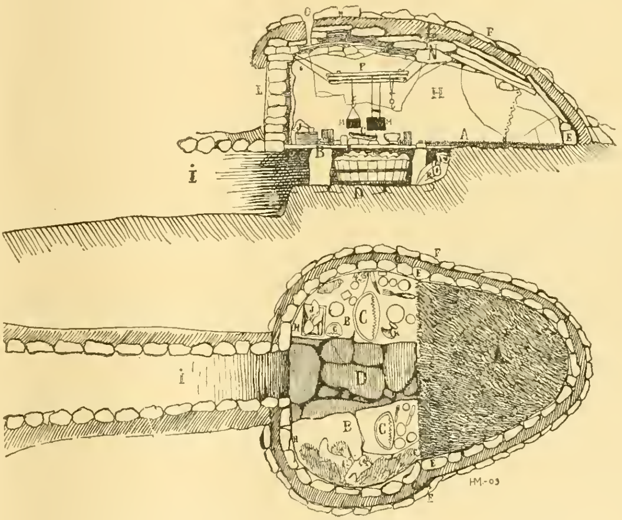


FIG. 1.—Elevation and Plan of an Eskimo Hut. From "The People of the Polar North."

Very little information about the physical characteristics of the Eskimos is given in this book, except what can be derived from the excellent representations of typical natives by Count Harald Moltke. The faces of the Polar Eskimos appear to be decidedly mongoloid. But all measurements of Eskimos hitherto made show that they have a very low cephalic index, not higher than 77, and in some groups as low as 73. This would appear to point to a cross between a mongoloid and some dolichocephalic race, such as was

[1] "The People of the Polar North." By Knud Rasmussen. Compiled from the Danish originals and edited by G. Herring. Illustrations by Count Harald Moltke. Pp. xix+358. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1908.) Price £1 1s. net.

to be found in Neolithic times in north-western Europe.

The portraits of the West Greenland type show that they approximate much more closely to the European type. These people live much further south, on the tracts of land left between the margin of the great Greenland glacier and the west coast. The West Greenlanders appear to have abundant supplies of food, obtained by hunting and fishing, walrus, seal, halibut, and salmon in the greatest abundance being readily obtainable by the active native. They are very hospitable and superstitious, the latter trait, according to the author, being due to the influence of the long winter night.

The East Greenlanders have now mostly migrated from the east coast to West Greenland. Apparently, before they moved, owing to their isolation they had reverted to a state of savagery and developed a kind of murderous mania which led to the most terrible tragedies. Now, when living amongst the West Greenlanders, they appear to have greatly advanced under the influence of the Danish missionaries.

FIG. 2.—Greenlandic Woman from Kangeq, near Godthaab. From "The People of the Polar North."

The map attached to the volume would be of much greater value if it contained more of the places referred to in the text.

This book, however, will take a high place as a study of the characteristics of an extremely interesting and fast vanishing people by a competent and sympathetic observer.

A HUMAN FOSSIL FROM THE DORDOGNE VALLEY.[1]

THE curtain which conceals the early history of our race is being in these last years lifted at frequent intervals to afford us glimpses into the distant past. Among the latest revelations are those by the Swiss explorer, M. Hauser, of a nearly complete human skeleton—not yet fully described—from a rock-shelter in the Vézère Valley, chinless, with the great orbits and retreating forehead characteristic of the Neanderthal type; and those still more recently made by the well-known prehistorians the Abbés J. and A. Bouyssonie and M. L. Bardon during their excavation of a cave opening in the vale of a small tributary of the Dordogne river, in the commune of La Chapelle-aux-Saints, in the Corrèze. Their careful and scientifically conducted excavations had previously, in 1905, been rewarded by the discovery of numerous quartz and jasperoid flint implements, scrapers (*racloirs*) and lance-heads (*pointes*), with others rather better finished and suggestive of the Aurignacian, which, taken with the entire absence of ruder amygdaloid implements (*coups de poing*) and of all worked bone, fixes with precision the archæological horizon as Late Mousterian. The fauna associated with these industrial relics includes reindeer, horse (rare), badger, woolly rhinoceros, marmot, wolf, fox, sheep or goat, a large bovine, and birds, and is characteristic of the cold climate of that epoch, which corresponds, in geological terms, to the Middle Pleistocene.

During last autumn the same three archæologists resumed their investigations, with the result that on August 3, while digging a trench in the cave, they uncovered a human skeleton, lying on its back, with the head, which was protected by stones, directed to the east. The right arm was bent so that the hand lay towards the body, the left arm was slightly extended, and the limbs were drawn up. Above the head were several large fragments of bone laid flat, while near by was placed the terminal phalanges of the hind hoof, with several of its associated bones, of a large bovine. The body was, therefore, intentionally buried, and as there is an entire absence of fireplaces it is concluded by the excavators, but probably not with universal accord, that the cave was not used as a dwelling, but only as a burying-place, where the abundance of bones and implements indicate only the holding of numerous funeral-feasts.

These human remains, which are of the greatest anthropological importance and interest, have been described by M. Marcellin Boule, the distinguished palæontologist, in a preliminary note read on December 14 last before the French Academy of Sciences, and published in the *Comptes rendus* of the academy cited below. The bones comprise a much broken cranium and mandible, vertebræ and limb-bones of a man of 1·60m. (a little more than 5 feet 2 inches) in stature. As the edges of the cranial fragments were unworn, it was possible to piece them very accurately together. The

[1] "L'Homme fossile de la Chapelle-aux-Saints (Corrèze)." Note de M. Marcellin Boule (*Comptes rendus de l'Académie des Sciences*, t. cxlvii., No. 24, December 14, 1908).

"Découverte d'un squelette Humain mousterien à La Chapelle-aux-Saints (Corrèze)." Note de MM. A. and J. Bouyssonie et L. Bardon (*Comptes rendus*, t. cxlvii., No. 25, December 21, 1908).

cranium, from the state of its sutures and its dentition that of an aged male, is remarkable for its size in comparison with the short stature of its owner, and for its simian or pithecoid characters. The skull is dolichocephalous (index 75), and remarkable for its thick bones, its flattened cranial vault, enormous brow-ridges (which are more prominent than in the original Neanderthal cranium), with a deep groove above them stretching from one orbital process to the other, for its much depressed occipital "bulging," for the backward position of the *foramen magnum*, the flattening of the occipital condyles, and the feeble development of the mastoid processes. The very prognathous face has large and prominent orbits, with a deep depression between them separating the short and very broad nose from the forehead. The upper maxillary differs widely from that in all living races of mankind, in projecting in front, into a sort of muzzle; while the palatine contour is very simian. The lower jaw is remarkable for its massiveness, the great width of its condyle, the shallowness of its sigmoid notch, the obliquity of its symphysis, and the absence of chin.

The La Chapelle-aux-Saints cranium, therefore, presents the characters, in some respects exaggerated, which distinguish the Neanderthal and Spy calvaria, all of which, though widely spread over Europe, but on about the same geological horizon, certainly belong, in M. Boule's opinion, to one type. Its mandible also presents the characters of the fossil mandibles, of the same age, known as Naulette, Spy, and Malarnaud. In the same palæontologist's estimation, the Neanderthal type should be considered a normal human type, characteristic of certain parts of Europe in the Middle Pleistocene. This type is different from, and lower than, any now living, for in no existing race are to be found united the low characters seen in the La Chapelle-aux-Saints cranium.

M. Boule, however, is not prepared to separate the Neanderthal-Spy–La Chapelle-aux-Saints group *generically*, but he would not hesitate to distinguish the La Chapelle-au-Saints man *specifically* from those of all other human groups, living or fossil. He considers it certain that the Neanderthal-Spy–La Chapelle-aux-Saints group represents a low type, nearer to the anthropoid apes than to any human group, and morphologically he would place them between Pithecanthropus and the lowest living races, yet without implying that they are in the same genetic line. The men of the Middle Pleistocene, judged by their physical characters and the relics of their industry, were in a primitive condition intellectually; while those who lived during the Upper Pleistocene possessed mental powers of a much higher order and were capable of producing true works of art, and their crania acquired the principal characters—the fine forehead, large brain, heaven-surveying countenance—of *Homo sapiens*.

A special interest attaches to the description given above of this new type of Homo, when we recall the various drawings of supposed "humans" left us by the men of the Upper Pleistocene on reindeer horn, ivory, and fragments of schist. These artists have depicted for us an extensive zoological picture-gallery, with a fidelity to nature hardly to be surpassed by any present-day artist. Their sketches are all from subjects with which they were intimately acquainted, and if there be forms among them which so far have not been recognised by us, we may rest assured that they were also reproduced from actual models. Among the palæolithic engravings much criticised are those of various anthropoid forms—such as the two accompanying examples (Figs. 1 and 2) from M. Piette and MM. Cartailhac and Breuil—which some ethnologists have hesitated to recognise as human, because of their pronounced simian characters. The description given above of the man of La Chapelle-aux-Saints seems to fit, in his snout-like jaws, semi-erect attitude, gibbon-like nose (especially Fig. 2), with wonderful exactitude, the drawings preserved to us at Mas d'Azil and elsewhere. Two very interesting questions suggest themselves: Are these pictures of a race surviving from the Middle Pleistocene? and, Were the artists of the Reindeer age depicting individuals of their own race? The present writer is convinced, and has long held, that they certainly depicted people contemporaneous with themselves, and reproduced them

Fig. 1.

Fig. 2.

as accurately as they did the bisons, horses, and rhinoceroses amid which they lived.

H. O. F.

BLACK-WATER FEVER.[1]

We have before us a very careful and detailed study of one of the most dangerous of tropical diseases, which has numbered many victims amongst Europeans of all ranks and classes in various parts of the world; the public that reads Nature will not need to be reminded of the sad death of that distinguished zoologist, Mr. J. S. Budgett, from black-water consequent on malaria contracted during his collecting expeditions in Africa.

The authors are especially concerned with the question of the nature and origin of black-water fever; the prophylaxis and treatment of the disease are dealt with very briefly. After a historical introduction the etiology of black-water fever is discussed and narrowed down to two alternative hypotheses, (1) that the disease is due to a specific organism, (2) that it is of malarial origin. It is then shown that the disease is not due to any parasite visible to critical microscopical examination, and that "the trend of evidence is steadily in favour of a malarial, as against a specific, origin." Facts are brought forward to show that in black-water fever the process of blood-destruction is what the authors propose to call "lysæmia," namely, "that condition, in which the red cells undergo solution in the plasma, and in which

[1] "Black water Fever." By S. R. Christophers and C. A. Bentley. Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India, No. 35. Pp. iv+239.

results true hæmoglobinæmia followed by hæmoglobinuria." Parasitic, osmotic, and chemical actions having been excluded as causes, it seems to the authors "most probable that black-water fever is due to some specific hæmolysin arising within the body" as the result of certain conditions, induced by repeated attacks or infections by malaria. The hæmolysin is believed not to be derived from the malarial parasites themselves, but to be thrown out by the cells of the body in response to stimulation, as a result of the constant phagocytosis of red cells. "If hæmolysins are formed against the blood there seems no agent so likely to effect this as the endothelium." The prophylaxis of black-water fever is "simply the prevention, as far as possible, of malarial infection, and the prompt and efficient treatment of this disease." In the palliative treatment of black-water fever the authors wish to show that "there are excellent reasons for believing that good results may be expected from serum-therapy."

The Government of India is greatly to be congratulated on the enlightened manner in which it aids forward the production, and undertakes the publication, of important and valuable investigations of this kind.

ANIMATED PHOTOGRAPHS IN NATURAL COLOURS.

THE production of photographs in colour by means that may fairly be described as photographic is now quite common. Though the simple method of getting pigmentary colours in the picture by the direct impact of the coloured lights proceeding from the object has not been, and may never be, realised, except, perhaps, to a certain extent by very prolonged exposures, the indirect three-colour process in its numerous modifications has thoroughly established itself as a quite practical method. It is natural, therefore, that endeavours to get kinematograph views shown on the sheet in natural colours should follow on the same lines that have made such great successes possible in single photographs.

Three-colour projection involves the taking of three negatives and the making from these of three suitably coloured positive transparencies which may then be superposed to form a single coloured transparency, or, using suitable colours, projected by three lanterns separately upon the screen and superposed there. The latter method would obviously commend itself in kinematography, because of the difficulty, if not the impossibility, of uniting three long strips into one, maintaining correct superposition from one end to the other. Besides, three lanterns would obviously give a good illumination on the screen more readily than one lantern. Many attempts, or at least suggestions, for it is difficult to know whether a verbal description really means anything more, have been made in this direction. Mr. G. Albert Smith, in a lecture recently given at the Royal Society of Arts, described the difficulties he met with in a really practical and persevering attempt, in conjunction with Mr. Charles Urban, to succeed on these lines. There was not only the difficulty of photographing with the necessarily short exposure through the red screen, which was eventually overcome, but the practical impossibility of getting correct, or even passably correct, registration of the three pictures on the screen. This is a very different problem in kinematography from the production of a single three-colour picture. Obviously the three series of photographs must be taken simultaneously, and although the three kinematograph cameras may be synchronised, as they are necessarily somewhat bulky, the three points of view must be separated, and this introduces differences in the pictures analogous to the differences between the individuals of a stereoscopic pair. But this is not the only difficulty. It is comparatively easy to get three pictures on the screen from three lanterns or a triple lantern correctly superposed when the lanterns are quite still; but it is a very different matter in the case of kinematograph projection apparatus, for here the film runs through it in a series of rapid jerks, and the slightest movement of the apparatus produces a very much increased effect on the screen, because of the very considerable magnification necessary. Mr. Albert Smith describes the result of his best attempts as "unbearable confusion."

All the mechanical difficulties of registration, and the dissimilarity of the photographs taken from three points of view, are done away with by using one film only and allowing the three coloured images to alternate. This has, further, the very great advantage of simplification, for the apparatus for taking and projecting is single only instead of three-fold. Of course, the film must pass more quickly through the apparatus, as it requires three pictures to form the single complete impression instead of one. The difficulties of this are obvious in a general sense, and it also means a shortening of the exposure time in taking the pictures, a disadvantage especially with the red and green screens. Still, the method was successful, but Mr. Albert Smith found the colours to be "washy and ineffective." It is not obvious why this must needs be so; probably the defect might have been remedied, but Mr. Smith applied himself to further simplification, and aimed, in spite of theory, at reducing the colour records to two. In this he has been surprisingly successful, as his demonstrations show. It is not easy to follow his reasoning as to the most suitable colours, but as a matter of fact it seems that he uses a red inclining to orange and a green inclining to blue. The two colour screens are on a disc that rotates in front of the lens so that each alternate picture is taken and afterwards projected through the one colour. Thus the ordinary apparatus is available by the addition of the rotating disc that carries the colour screens, there is no difficulty with regard to registration, and the increase in speed of working, as compared with the ordinary kinematography, is doubled only instead of tripled. Doubtless there are imperfections in the colours, but the same may be said of all three-colour work. It has, however, been demonstrated that greys are fairly well reproduced, and that there are no striking errors even in such compound colours as purples. A comparison of the results so obtained with an autochrome slide made of the same view shows practically no difference to the ordinary observer. We may therefore say that Mr. Albert Smith's method is not only very good as a first step towards kinematography in colours, but that it is a really practical method.

PROF. H. G. SEELEY, F.R.S.

THE death of Prof. H. G. Seeley, which took place at his residence on the morning of January 8, makes a big gap in the ranks of the comparatively small body of British vertebrate palæontologists, among whom the deceased professor was entitled to rank as the *doyen*. Born in London in February, 1839, he seems to have acquired literary and scientific tastes at an early age, and in the 'sixties we find him established at Cambridge, where he was taken up by the late Prof. Adam Sedgwick, and employed to work at the fossil vertebrates then being rapidly accumulated in the Woodwardian Museum, and likewise to lecture on geology when the aged professor was incapacitated from doing so by infirmity or illness. It was at this time that the so-called coprolite diggings

were in full swing in the neighbourhood of Cambridge, and Seeley was to the fore in bringing to light what was to a great extent a new Mesozoic vertebrate fauna, albeit one of which the remains were for the most part in a sadly fragmentary condition.

This was, in fact, the first of Seeley's two great opportunities in this field of research, and he undoubtedly made the most of it, for it is to him that we owe the first discovery of birds in Cretaceous strata—birds which, as Prof. Marsh subsequently showed, retain evidence of reptilian affinity in the possession of a full series of teeth. Much information was likewise acquired at the same time in regard to the structure of pterodactyles, of which numerous remains were obtained in the coprolite workings. The results of these studies were published in a somewhat bald form in a preliminary "index" to the remains of Mesozoic birds and reptiles in the Cambridge Museum.

Although entered as a student at Sidney Sussex College, Seeley never took a degree, and soon after Sedgwick's death he left Cambridge for London, where in 1876 he was appointed to the chair of geography at King's College. In the same year he was chosen professor of geography and geology at Queen's College, London, while five years later he was appointed dean of the college. In 1890 he commenced lecturing on mineralogy and geology at the Royal Indian Engineering College at Coopers Hill, and a year later was appointed to fill the post previously held by Prof. Martin Duncan. Finally, in 1896, he became professor of geology and mineralogy at King's College. As if all this was not work enough for any man, he likewise conducted for many years the excursions of the London geological field class.

In 1862 Prof. Seeley was elected a Fellow of the Geological Society, and in 1879 he was admitted to the fellowship of the Royal Society, while in 1905 a fellowship at King's College was awarded him. He served on more than one occasion on the council of the Geological Society, from which body he also received a medal. The honorary memberships of foreign scientific bodies accorded in honour of his labours are too numerous to mention on this occasion.

The second great opportunity in his career came in 1889, when, under the auspices of the Royal Society, Seeley started for South Africa in order to collect and study the remains of the marvellous anomodont reptiles which render that country of such intense interest to the palæontologist. On his return, he spent a large amount of time and labour on working out his collections, many of the results of these studies being published by the Royal Society in its Transactions. As each section of the work was completed, such specimens as were his own property were presented to the natural history branch of the British Museum, where they form some of the most prized treasures of the fossil reptile gallery.

In this investigation Prof. Seeley definitely recognised the intimate relationships existing between the anomodont reptiles and the lower mammals, a matter on which previous writers had displayed some degree of hesitation and wavering. If he had done nothing else, his claims to a high place in the records of palæontology would have been fully established by the recognition of this one great fact. For the trend of all subsequent work has been to emphasise the intimacy of this relation between mammals and the anomodonts.

In several respects Prof. Seeley was unlike other men, so that his work can scarcely be judged by the ordinary standards, and the time for a final judgment has not yet arrived. That palæontological (to say nothing of geological) science has lost a student with an almost superhuman store of knowledge is, however, admitted by all. R. L.

NOTES.

On December 31, 1908, Mr. H. B. Woodward, F.R.S., retired from the Geological Survey of Great Britain, after more than forty years' service. His post as assistant to the director has been taken by Dr. A. Strahan, F.R.S., and the vacancy in the district geologists thus created has been filled by the promotion of Mr. George Barrow.

A poll has been taken of the proprietors of the London Institution in connection with the proposal to amalgamate the institution with the Royal Society of Arts. The result shows that the majority of the proprietors are in favour of the scheme for the amalgamation of the two societies. A meeting of the board of management of the London Institution is therefore being held as we go to press to consider the next step to be taken.

Prof. J. Arthur Thomson, of Aberdeen University, has been invited by the lecture committee of the South African Association for the Advancement of Science to give the "South African Lectures" for 1909. The lectures are to be delivered in August and September in Johannesburg, Pretoria, Bloemfontein, Kimberley, Cape Town, Grahamstown, and Durban, and at the request of the committee they will have special reference to the Darwin centenary. The previous lecturers were Prof. Raleigh, Magdalen College, Oxford, and Mr. Herbert Fisher, New College, Oxford.

The Paris correspondent of the *Times* reports that on January 6 the driver of the Côte d'Azur express was attacked by an eagle while the train was proceeding from Chalon sur Saône to Fontaines station. The bird, which measured 2 metres across the wings, flew into the cab of the engine, and was only overcome after a severe struggle.

We regret to notice in *Science* the announcement of the death on December 19, 1908, at the age of fifty-eight years, of Prof. Thomas Gray, professor of dynamics and engineering at the Rose Polytechnic Institute, and distinguished for his work in these subjects.

We regret to see the announcement of the death, on December 25, 1908, of Major Percy B. Molesworth, R.E., in the forty-second year of his age. He died at Trincomali, Ceylon, where he had been stationed for some years. Major Molesworth was one of the most careful and assiduous of planetary observers, especially of Jupiter and Mars. He published in the Monthly Notices of the Royal Astronomical Society a long series of observations of Jupiter made in 1903–4, and recorded what appears to be a unique instance of perceptible change on the planet's surface in the course of a few minutes. He made a series of observations, amounting to many thousands, of transits of spots on the planet, the results of which were published in the Memoirs of the British Astronomical Association, of which he was one of the most devoted members of the observing sections. He made a fine series of observations and drawings of Mars, extracts from which were published in the Monthly Notices, the full report being placed for reference in the library of the Royal Astronomical Society, of which society he had been a fellow since 1898. He was a member of the British Astronomical Association from its foundation.

A medical congress, due to the initiative of Sir George Clarke, the Governor, is to be held in Bombay, and will begin on February 22. On the opening day Sir George Clarke will deliver the presidential address, and the sectional meetings will last during the next four days. There will be an exhibition of medical, surgical, and sanitary

appliances. Among others concerned in research work specially affecting India who have expressed their intention of being present at the congress meetings are Profs. Ronald Ross, Kitasato, and Musgrave. Papers are expected to be communicated by Sir Patrick Manson, Sir Lauder Brunton, Prof. Osler, and others. The attendance at the congress is expected to be very large. The secretary of the congress is Colonel Jennings, c/o Messrs. King, King and Co., Bombay.

We regret to see the announcement of the death of Dr. D. A. Robertson, the distinguished surgeon-oculist, at seventy-two years of age. Dr. Robertson was for several years lecturer on ophthalmology in the University of Edinburgh, and he was president of the International Ophthalmological Congress in 1894. He was an ex-president of the Ophthalmological Society of the United Kingdom, and was president of the Royal College of Surgeons, Edinburgh, in 1886, president of the ophthalmological section of the British Medical Association in 1898, and president of the Edinburgh branch of this association.

Many geologists and other friends and fellow-workers of the late Mr. Joseph Lomas will welcome the opportunity of subscribing to a memorial fund which is being raised for the benefit of his wife and children. As was mentioned in Nature of December 24, 1908 (p. 226), Mr. Lomas was killed in a railway accident in Algeria while on his way to study the rocks in the desert region of North Africa, this investigation being undertaken for a committee of the British Association. The devotion to scientific work which characterised Mr. Lomas meant the sacrifice of time and means that might otherwise have been used more selfishly. It is not surprising, therefore, to know that he was unable to make adequate provision for his wife and children. There should be a generous response to the appeal which has just been issued by a committee which includes the names of many distinguished men of science who knew Mr. Lomas, and of which Prof. W. A. Herdman, F.R.S., is one of the hon. treasurers. Subscriptions should be sent to the hon. treasurers, "Lomas Memorial Fund," Education Committee, 14 Sir Thomas Street, Liverpool.

On Tuesday next, January 19, Prof. Karl Pearson will begin a course of two lectures at the Royal Institution on "Albinism in Man"; on Thursday, January 21, Prof. J. O. Arnold will commence a course of two lectures on "Mysteries of Metals," and on Saturday, January 23, Sir Hubert von Herkomer delivers the first of two lectures on (1) "The Critical Faculty," (2) "Sight and Seeing." The Friday evening discourse on January 22 will be delivered by Dr. Alfred Russel Wallace, on "The World of Life: as Visualised and Interpreted by Darwinism," and on January 29 by Sir Frederick L. Nathan, on "Improvements in Production and Application of Guncotton and Nitro-glycerin."

Since the great earthquake in Sicily and Calabria on December 28, 1908, there have been a number of aftershocks, and a little additional information about the disturbance. Prof. Oddone informed a Press representative on January 6 that the observatory building at Messina has been damaged, but a subterranean chamber used for seismic investigations has escaped harm. The Vicentini seismograph registered the great earthquake up to the moment of maximum intensity, and the record is considered to be of considerable interest in the study of the earthquake. From the record it appears that the earthquake began with a very slight shock, which was repeated. It increased in violence for ten seconds, and then grew less severe for another ten seconds. After these movements ten minutes passed without disturbance. A second shock of much greater intensity, and accompanied by loud subterranean rumbling, followed, and was the cause of the catastrophe. In the afternoon of January 7 several distinct shocks were felt at Reggio. Shocks continued during the whole of the night, some of them being strong ones preceded by a humming noise. On January 8 the entire west coast of Mexico was shaken by an earthquake. Three strong earthquake shocks were felt at Messina between 12.15 p.m. and 12.30 p.m. on January 9. Reuter telegrams to New York from Seattle, Bellingham, Tacoma, Vancouver, and Victoria state that an earthquake shock was felt in those places at 3.44 p.m. on January 11, and again during the evening.

We learn from the Journal of the Royal Society of Arts that Sir Thomas Wardle, who died at his residence, Leek, Staffordshire, on January 3, in his seventy-eighth year, was the first business man to discover a satisfactory process of dyeing the wild *tussur* silk of India, and, at the instance of Sir George Birdwood, he was sent out by the Secretary of State for India, in 1885, to report on sericiculture in Bengal. This was the first of several visits to the East, and in his work, "Kashmir and its New Silk Industry" (1904), Sir Thomas Wardle gave an account of the manner in which, mainly through his instrumentality, the moribund industry was, after innumerable difficulties, placed upon a footing of greater prosperity than it had ever enjoyed before. He wrote numerous monographs upon the technical aspects of sericiculture and silk-weaving, and he was the honorary expert on silk of the Imperial Institute, president of the Silk Association of Great Britain and Ireland, and honorary secretary of the Ladies' National Silk Association. He was a Fellow of the Chemical, Geological, and Royal Statistical Societies, and a member of the council of the Palæontographical Society. He became a member of the Society of Arts in 1878. In the following year he read his first paper, on the wild silks of India, principally tussur, for which he received the society's silver medal. Since then he contributed three papers, on researches on silk fibre, the history and description of the growing uses of tussur silk, and improvements in the design, colouring, and manufacture of British silks.

The arrangements made by the British Meteorological Office for the transmission of meteorological reports by wireless telegraphy from ships at sea were referred to in last week's Nature (p. 287). The annual summary of the work of the U.S. Weather Bureau, recently published in the *Monthly Weather Review*, describes what is done in this direction in connection with that Bureau. The essential feature of this weather service is the collection by wireless telegraphy of meteorological observations from vessels at sea, and the dispatch by the same means to vessels at sea of weather forecasts and storm warnings based upon the observations thus collected. Vessels of the following lines, all equipped with Marconi apparatus, have been authorised to transmit to the Bureau the record of the daily Greenwich mean noon meteorological observations, and have been supplied with the telegraphic code, forms, &c., required for that purpose:—American Line, North German Lloyd, Hamburg American Line, Cunard Line, White Star Line, Compagnie Generale Transatlantique, Allan Line, and Canadian Pacific Steamship Line. The privilege has also been extended to vessels of the Panama Railroad and Steamship Company and the Mallory Line, equipped with the De Forrest system; also

to the Pacific Steamship Company, equipped with the Massie system. There appears to be only one vessel on the Pacific carrying wireless apparatus. Other vessels are said to be in course of equipment, and the wireless weather service on that coast, in view of its supreme importance in the matter of local forecasting, is to be prosecuted with vigour. The wireless telegraphic weather service and code have also been adopted by the U.S. Navy Department, and all vessels of the U.S. Navy are instructed to transmit the daily weather despatch while at sea. The wireless telegraphic stations controlled by the Navy Department are also required to receive weather messages from merchant vessels and to transmit them to the Bureau, likewise to dispatch the weather forecasts and storm warnings issued by the Bureau to vessels at sea demanding them, free of cost. The total number of wireless weather reports received during 1907 from vessels at sea was 738. Of this number, 679 were from Transatlantic liners distributed along the route between Sandy Hook and longitude 44° west.

RECENTLY, Indiana University came into possession of a farm of about 180 acres, celebrated for its natural beauty and for the possession of a subterranean stream, which comes to the surface in two places before finally emerging from the base of a cliff in one of the most picturesque cave-entrances in America. Of the fauna of this tract a comprehensive account is given by Mr. W. L. Hahn in No. 1655 of the Proceedings of the U.S. National Museum, the most interesting element in this being formed by the denizens of the caves and underground stream.

IN its report for the year ending on September 30 last, the committee of the Bristol Museum and Art Gallery refer to the visit to that institution paid by their Majesties the King and Queen on the occasion of their coming to the city to open the Royal Edward Dock at Avonmouth. Lady Smyth, widow of Sir Greville Smyth, of Ashton Court, contributed during the year a munificent donation for the purpose of fitting up a room for the display of the collection of invertebrates made by her late husband and presented by herself, this chamber to be called the "Greville Smyth Room."

THE heronries of Lincolnshire and Somersetshire form the subject of an article by the Rev. F. L. Blathwayt in the *Zoologist* for December, 1908. Formerly the south-eastern portion of Lincolnshire was renowned for the number of its heronries, which included those of Leake (near Boston), Spalding, Donington, and Cressy Hall, all of which are now extinct. The Leake heronry occupied a very large tree, which was literally covered with nests, until it was felled about the year 1830; while the Cressy heronry, which was described by Pennant in 1769, contained some eighty nests. At the present day only five heronries in the county are known to the writer, the largest of which is reported to contain twenty pairs of birds.

THE *Journal of Comparative Neurology and Psychology* for November, 1908 (vol. xviii., No. 5), contains an English translation of a masterly address delivered before the third congress for experimental psychology by Dr. Ludwig Edinger, on the relations of comparative anatomy to comparative psychology. Great results, it is urged, would ensue if these two sciences were practically studied together, as is demonstrated by what has been already accomplished whenever such a union has taken place. The author lays great stress, from a psychological point of view, on dividing the brain into a "palæencephalon" and a "nëencephalon," the latter comprising the hemispheres, and the former all the remainder of the structure. The palæencephalon is alone present in bony fishes, and since in all vertebrates a totally different (nëencephalic) type of activities makes its appearance, the importance of a close psychological study of fishes is self-evident. Not only all the activities commonly termed reflex, but all instincts are localised in the palæencephalon, as is demonstrated by the fact that flight when surprised, migrations, nest-building, courtship, and many other activities are noticeable in the bony fishes. With the appearance of the nëencephalon the behaviour of the animal undergoes a complete change. Something has been done in assigning their proper functions to the various divisions of the brain, but a vast amount of work still remains to be accomplished in this field; such investigations must, however, be carried on both anatomically and psychologically at the same time, when observations on the living animal are impossible, if any good result is to accrue.

IN the December (1908) number of the *Bio-Chemical Journal* (iii., No. 10) Prof. Moore discusses the question of variation of the amount of free hydrochloric acid of the gastric contents in cancer, particularly in relation to some recent criticisms of his results, and maintains that, generally, the free hydrochloric acid of the gastric contents is diminished in cancer cases, no matter in what part of the body the disease is situated.

IN the Bulletin of the Johns Hopkins Hospital for December, 1908 (xix., No. 213), Mr. Victor Bloede discusses a comprehensive scheme for dealing with tuberculosis. It contemplates the combined and simultaneous operation of four agencies, each indispensable in itself:—(1) the dispensary where the cases are investigated, diagnosed, and classified; (2) the hospital for advanced cases; (3) the sanatorium for incipient cases; (4) the farm colony for the after-treatment of arrested cases, where the patients receive further benefit to their health and are gradually restored to the rank of self-respecting workers, as well as contributing something to the upkeep of the institutions.

WE have been favoured with a copy of the exchange list of seeds of hardy herbaceous plants and of trees and shrubs issued by the director of Kew Gardens as Appendix I. to the *Kew Bulletin* of the current year.

IT is noted in the report for 1907–8 on the botanic station, Montserrat, that the cultivation of cotton on the island is making very favourable progress, as the out-turn was double that of the previous year. Of various experiments carried out by the curator, Mr. Robson, the one most generally interesting was intended to ascertain whether the clean and fuzzy cotton seeds produced plants true to type; such was found generally to be the case, and fortunately so to a larger extent in the case of the fuzzy seed that is associated with the better quality of lint.

THERE is a conflict of opinion regarding the value of the special bacterial cultures that have been introduced with the view of increasing the nodule formation, and therefore the productiveness, of leguminous plants. Experiments with nitro-bactrine, carried out at the Royal Horticultural Society's Gardens, and described in the Journal (vol. xxxiv., part ii.) by Mr. F. J. Chittenden, are decidedly adverse. Trials were made with inoculated soil and inoculated seed both on untreated and manured soil; but despite the fact that the soil is naturally lean, and therefore, it would be supposed, specially suitable for inocu-

lation, the nitro-bactrine effected no improvement in the crops. It should be noted that all the experiments were confined to the cultivation of peas.

Two papers occupy a large portion of the nineteenth report of the Missouri Botanical Garden. Mr. C. S. Sargent contributes a memoir on the species of the critical American genus Cratægus found in Missouri. He identifies no fewer than 110 species, of which a large number are endemic, and more than half are new to science; this, by the way, is said to be a preliminary study. The second paper, dealing with the types of vegetation found in a normal cross-section taken across the Mississippi River near St. Louis, is communicated by Mr. H. Hus. The physiographical divisions on either side of the river are distinguished as bottom-lands, bluffs, and highlands. Forests and limited prairies are characteristic of the highlands. In the forests the black oak, *Quercus coccinea*, associated with other oaks and hickories, is dominant. Curious features are the sink-holes, originally forming entrances to caves, that have in many cases been closed, when the holes have been transformed into ponds. *Hydrastis canadensis*, *Polygonatum giganteum*, and *Arisaemum triphyllum* are characteristic plants found therein.

BULLETIN No. 118 of the Perdue University Agricultural Experiment Station, drawn up by Messrs. Troop and Woodbury, contains popular instructions for fruit-growers on various common orchard pests. Methods of recognition are given and remedial measures are described; there is also a good deal of sound advice on general management. Bulletin No. 116 of the West Virginia University Agricultural Experiment Station deals with the same subjects as they affect the West Virginian fruit-grower. In view of the increasing attention that is being devoted in this country to the improving of orchards, and in particular to spraying, English horticultural instructors will find much to interest them in these publications.

THE Imperial Agricultural Department of the West Indies has issued a bulletin, by Mr. Stockdale, dealing with the fungus diseases of cacao and the sanitation of cacao orchards. The diseases described are canker, "die-back" (caused by *Diplodia cacaoicola*), lasiodiplodia, "pink disease" (caused by *Corticium lilaco-fuscum*), thread blights (*Marasmius equicrinus* and other fungi), witchbroom disease (*Exoascus theobromae*), and others. Most of these diseases have been under experiment for some years, having been investigated by Mr. Howard in 1901, and it has been satisfactorily demonstrated that they are amenable to treatment. The methods found to be most effective are collected together, and the bulletin thus affords an interesting survey of the work done up to the present on this particular subject.

THE current issue of the *Transvaal Agricultural Journal* is up to its usual high standard, and includes a number of articles of local importance, besides others of more general interest. Dr. Theiler gives an account of the results he has obtained by inoculating sheep against blue tongue. He finds that vaccination is more effective, and attended with less risk, than the older method of simultaneous serum and virus injection. The mortality returns from vaccinated portions of the flocks compare instructively with those from unvaccinated portions; 11 per cent. of the unvaccinated sheep died, but only 0·4 per cent. of those vaccinated. It is a matter of fundamental importance to the Transvaal farmer, and of great credit to the Transvaal Agricultural Department, that this disease should have been brought under control. The number of diseases, both of animals and of plants, in the Transvaal is great, but is steadily being rendered less formidable by the persistent efforts of the Agricultural Department.

THE work of the agricultural experiment station in connection with the University of Maine is at the present time organised under four departments—chemistry, entomology, vegetable pathology, and biology. The work is entirely investigational, except in the department of chemistry. With a single exception, none of the staff does any teaching or has any duties other than those directly connected with the work of his department. We have received a report on the work of the biological department. The general problem on which the department is working is that of genetics, which is studied by observational, experimental, and statistical methods of biological investigation. The work is carried on in two laboratories. In addition, the department has available what is probably one of the largest and best equipped experimental poultry plants anywhere in existence. The work in plant breeding proper and on any problems which involve the use of plants as material is at the present time being carried on on rented land. The work of the department falls at present into three general lines of investigation as follows:—genetics, physiology of reproduction in the domestic fowl, and the laws of growth. Each of these topics may be considered somewhat in detail. The work in *genetics* includes hybridisation studies, the influence of selection upon the inherited characters of organisms, and quantitative studies of the method and degree of inheritance of various characters in plants and in poultry. Under the physiology of reproduction are being studied the physiology of egg production within the individual, the physiology of egg production within the race, the influence of environmental factors (in the broadest sense), the relation of internal factors to, and their influence upon, processes, and the pathological and teratological cases relating to egg production. During the present year a detailed study of the growth of the maize plant has been made, with particular reference to the following factors:—gametic constitution of the growing individual, intra-individual variation, and racial variation.

IN the *National Geographic Magazine* for December last Mr. A. J. Mayer describes a cruise along that most neglected part of the Atlantic coast lying between the mouth of Chesapeake Bay and north Florida. In the course of the voyage we pass from a temperate region of chestnuts and beeches to the border lands of the tropics in the Florida palmetto groves. In the animal world there is ample evidence of the wanton destruction of life—waterfowl, wild turkey, deer, bears, and alligators—while the forests are disappearing under the axe or are being destroyed by the wasteful turpentine industry. Unless early measures are taken to conserve the game and forests, a region which might become the favoured haunt of the sportsman and naturalist will be converted into a barren waste.

THE January issue of the *Reliquary* contains two useful articles on early ceramics. The first, by Mr. A. G. Wright, curator of the Colchester Museum, describes the collection of late Celtic and Roman pottery in his charge, which, for the number of specimens and the great variety of wares, is probably unequalled in northern Europe. Specially remarkable is the splendid cinerary urn of the Bronze age, the second largest of its class discovered in Britain, the other and greater example being preserved in the Devises Museum. Among the vessels of the Iron

age, the pedastelled vases, derived, as Dr. A. J. Evans has pointed out, from the Situla in vogue south of the Alps about the fourth or fifth centuries B.C., deserve notice. Two groups of fine Celtic sepulchral vessels found at Colchester and Braintree are figured and described. The second paper, by Mr. M. E. Cunnington, discusses a find of fragments of Arretine ware from a late Celtic rubbish-heap at Oare, in Wilts. This ware is particularly rare in England, because just about the time when this country came under Roman domination it was superseded by the red-glazed Gaulish ware from the potteries established at Graufesenque in the middle of the first century A.D.

PROF. T. LEVI CIVITA has published in the *Atti dei Lincei*, xvii. (2), 1, a discussion of the attraction exerted by a material line on points in its immediate neighbourhood. The object is to discuss, by rigorous methods of modern analysis, the asymptotic forms to which the potential and its derivatives tend as the point approaches and ultimately lies on the line itself. The same methods are applicable, as Prof. Levi Civita shows, to the vector potential of a vortex filament. This corresponding hydrodynamical problem was first discussed by Da Rios in 1906. Readers of ordinary text-books will know that the expression for the translational velocity of a circular vortex commonly given contains a logarithm which becomes infinite at a point on the vortex itself. In a further paper in the same journal (xvii. [2], 9) the attraction of a thin tube of finite density is discussed.

ON December 7, 1908, Mr. Herbert Chatley gave a lecture on mechanical flight before the Society of Engineers. The printed account of the lecture contains about as clear and concise a statement of the present position of the problem as could possibly be condensed into fifteen pages. The relative advantages of the aëroplane, helicoptère and ornithoptère are briefly stated, but the point most emphasised is the need for scientific research both in connection with the study of air resistance and in connection with stability. These researches are bound to come sooner or later, for the work is perfectly well defined and straightforward, and want of opportunity has been the only hindrance which has given the lead to methods of trial and error. Mr. Chatley does not anticipate that aërial navigation will cause any great revolution in war and commerce for some years to come. He, however, wishes to point out the deplorable backwardness of English invention in this direction.

PROF. M. LAUE, in the *Physikalische Zeitschrift*, ix., 22, pp. 778–80, directs attention to an apparent paradox in the application of the concept entropy to radiation phenomena. If a beam of light falling on the surface separating two media is broken up into a reflected and a refracted beam, the two are capable of being re-united, under ideal conditions, into a single beam, and no entropy change can accompany the process. On the contrary, two beams from different sources, but identically similar in all other respects (non-coherent beams), cannot be so united, and their total entropy is apparently greater than that of the original beam. According to the statistical or probability definition of entropy, the difference is easily accounted for. On the thermodynamic aspect, the entropy of the coherent beams as a whole appears different from the sum of the entropies of the parts if the latter are estimated for each part independently without taking account of the presence of the other. The properties do not appear to be out of accord with the laws of thermodynamics so far as these are defined in terms of changes of available energy due to irreversible transformations. The available energy of a beam of light is increased by the presence of a coherent beam, and if a pair of such beams could be generated from independent sources we should undoubtedly be able to overcome the second law (and make our fortunes?), but such a possibility is contrary to existing experience.

THE method of thermal analysis, *i.e.* the observation of the change of temperature with time of a material in a cooling furnace, has been used so extensively in metallurgical research during the last twenty years, and has assumed so many different forms in the hands of experimenters, that the critical examination of the various methods from both experimental and theoretical points of view which Mr. G. K. Burgess contributes to the November (1908) number of the Bulletin of the Bureau of Standards will be welcomed by all metallurgists. Mr. Burgess comes to the conclusion that from both points of view the most certain and complete data may be obtained by combining the observations of variation of temperature with time with those obtained by taking the differences of temperatures of the material under test and a standard material cooling under the same conditions. He points out, however, that for accurate quantitative work it will be further necessary to take into account the effect of the cooling of the furnace itself on the rate of cooling of the specimen within it.

IN NATURE of November 19, 1908 (vol. lxxix., p. 75), Prof. Perry directed attention to the admirable pioneer work in the practical teaching of science and technology done by the late Prof. Ayrton so long ago as 1879 at the Finsbury Technical College. Sir Oliver Lodge, in a letter to NATURE (vol. lxxix., p. 129), supplemented this information by an account of similar work accomplished, certainly in 1872 and perhaps as far back as 1866, at King's and University Colleges in London by Prof. Carey Foster and others. Prof. Chas. R. Cross, of the Massachusetts Institute of Technology, Boston, U.S.A., now sends us a printed copy of a report on the physical laboratory of the institute written by Prof. E. C. Pickering, then Thayer professor of physics at the institute, which shows that in 1864 President Rogers proposed a laboratory for the institute in which "the student may be exercised in a variety of mechanical and physical processes and experiments"; and in October, 1868, "a room was opened to advanced students where they carried on physical investigations, as is done by many physicists with their special students." It appears evident that even more than forty years ago several men of science were beginning to appreciate the need, which is now recognised universally, for properly organised experimental work by students themselves if the instruction given in physical science is to be thorough and satisfactory.

THE Berlin Photographic Company, 133 New Bond Street, W., has sent us several portraits of distinguished men of science from a collection published by the company under the title "Corpus Imaginum." The portraits are photogravures on plate paper, the size of the picture itself being in each case about 6 inches by 9 inches, and the price of each plate is 3*s.* We have no hesitation in saying that the portraits are extremely fine, and that they should decorate the walls of many studies and schools. The portrait of Lord Kelvin, which is among the selection sent to us, is certainly the truest picture of him we have ever seen. Among other eminent men of science included in the collection published by the company are Bunsen, Cuvier, Darwin, Faraday, Helmholtz, Herschel, Huxley, Liebig, Lister, Mendeléeff, Newton, Owen, Pasteur, Sir

W. Ramsay, Richthofen, and Tyndall. We miss, however, a number of well-known names, as, for instance, the following, who have occupied the president's chair of the Royal Society:—Sir Joseph Banks, Sir Humphry Davy, Sir Joseph Hooker, Sir George Stokes, Sir William Huggins, Lord Rayleigh, and also the present president, Sir Archibald Geikie. Perhaps the company will be able to extend its collection of portraits by the addition of these and a few other British men of science of world-wide renown.

THE Selborne Society has revived the old title of its magazine, which will henceforth be called *The Selborne Magazine (and Nature Notes)*, and will be published by Messrs. George Philip and Son, Ltd., 32 Fleet Street, E.C. All communications with regard to the society should be addressed to the honorary general secretary, Selborne Society, 20 Hanover Square, London, as heretofore.

THE January number of *Knowledge and Scientific News*, which is the first number of the enlarged series, contains a five-page illustrated article on the Cavendish Laboratory and Sir J. J. Thomson from the pen of Dr. A. Wood, who has himself worked in the laboratory for the last half-dozen years. He gives an outline of the history of the laboratory, and points out the prominent position it has taken in the march of science during the last twenty years. Views of the original laboratory and of the extension recently opened by Lord Rayleigh are given, but readers will value most the excellent reproduction of the portrait of Sir J. J. Thomson, in which he has his hand on the commutator of an induction coil and his keen eye on the vacuum tubes in front of him.

OUR ASTRONOMICAL COLUMN.

FURTHER PHOTOGRAPHS OF MOREHOUSE'S COMET.—Prof. Barnard describes, and reproduces, more photographs of comet 1908*c* in the December (1908) number of the *Astrophysical Journal* (vol. xxviii., No. 5, p. 384). The four reproduced were selected because they illustrate so well the remarkable changes which took place in the comet; they were taken on October 14, 15, 16, and 30, 1908.

These changes have been described before, but Prof. Barnard directs attention to one or two peculiarities of especial interest. A comparison of the plates taken on October 15 and 16 appears to indicate that there was no acceleration of the motion of the ejected matter in the direction of the length of the tail. From the photographs taken on the former date it appears to Prof. Barnard that the ejected masses moved southwards at a greater rate than did the comet, thus producing the observed changes in position angle of the various sections of the tail.

Prof. Barnard believes that the masses forming the tail were actually ejected by the action of the comet itself to a large extent, and states that both in this and in Daniel's comet he observed pulsations of light at irregular intervals, such as might be expected to accompany the violent actions which would eject such masses. He also directs attention to the great difference between the visual and the photographic brightness of this comet; in a moonlit sky the tail could not be observed visually, yet a good photograph, showing an extension of eight or nine degrees, was obtained when the moon was $10\frac{1}{2}$ days old.

According to the measures of the photographs taken on October 15 and 16 respectively, the uniform value of the recession of the detached masses was about $3'{\cdot}5$ per hour.

SEARCH-EPHEMERIS FOR HALLEY'S COMET.—A search-ephemeris for Halley's comet, submitted by an unnamed competitor for the Astronomische Gesellschaft prize, appears in No. 4295 of the *Astronomische Nachrichten* (p. 369, December 31, 1908). It gives the computed positions of the comet at intervals of ten days for the present year, and for every fourth day, commencing at January 2, in 1910. Observers should remark that this ephemeris differs, for the present epoch, from that previously given by Messrs. Cowell and Crommelin, whilst the difference between it and that computed by Dr. Smart (Monthly Notices, March, 1908, p. 394), for January 2, 1910, amounts to more than 3h. in R.A. and to nearly 4° in declination.

THE DISTRIBUTION OF ERUPTIVE PROMINENCES ON THE SOLAR DISC.—Some interesting statements concerning the nature and distribution of eruptive prominences on the sun's disc, and of their relations to spots, are made by Mr. Phillip Fox in No. 4, vol. xxviii., of the *Astrophysical Journal*.

From observations made with the Rumford spectroheliograph, Mr. Fox deduces that the especially brilliant points in the flocculi adjacent to spots, designated "eruptions" by Hale and Ellerman, are the bases of eruptive prominences. Evidence of this has accrued from the fact that when these eruptions have been observed near the limb, they have been found to coincide with eruptive prominences projecting above the limb.

The position of these eruptive prominences in relation to spots leads to the conclusion that the spot is preceded by, and has its genesis in, an eruption; this appears to be so generally the rule that Mr. Fox thinks it is safe to predict the advent of a spot whenever an isolated eruption is observed.

An examination of all the Hα spectroheliograms shows that solar vortices are counter-clockwise in the northern and clockwise in the southern hemisphere.

Mr. Fox suggests that the location of eruptive prominences between the members of well-developed spot groups, and their absence in front of the leading spot, may be due, at least in part, to the interference of the whirls circulating around the various spots.

DOUBLE-STAR ORBITS.—The orbits of η Cassiopeiæ and γ Coronæ Borealis are re-discussed, in the light of the more recent observations, by Prof. Doberck in No. 4296 of the *Astronomische Nachrichten* (pp. 383–6, January 2), and revised elements are given for each.

According to these elements, the period of the former star is 507·60 years and the eccentricity of the orbit is 0·5220, whilst for γ Coronæ the corresponding figures are 81·49 years and 0·3908.

ERRORS IN MEASURES OF STAR IMAGES AND SPECTRA.—Some results of great importance to those concerned in the photographic determinations of stellar positions, and of the wave-lengths of stellar spectra, are published by Prof. Perrine in Bulletin No. 143 of the Lick Observatory.

The experience of everyone engaged in such work is that the discordances found in the measures are greater than can be accounted for by errors of measurement alone, and, whilst developing the method of determining stellar parallaxes by photography, Prof. Perrine has investigated the source of the outstanding discordances. His results indicate that the irregularity, in size and distribution, of the grains in the photographic film is the chief source of the trouble. Instead of each star image being a regular collection of equally sized grains, it is a complicated and irregular gathering of particles intersected by lanes and vacant spaces, and composed of bodies of different sizes. This irregularity leads to errors of setting, because the centre of such an agglomeration is so indefinite, and may depend more upon the structure of the particular part of the film acted upon than upon true position of the area illuminated.

PHYSICAL OBSERVATIONS OF THE NATIONAL ANTARCTIC EXPEDITION.[1]

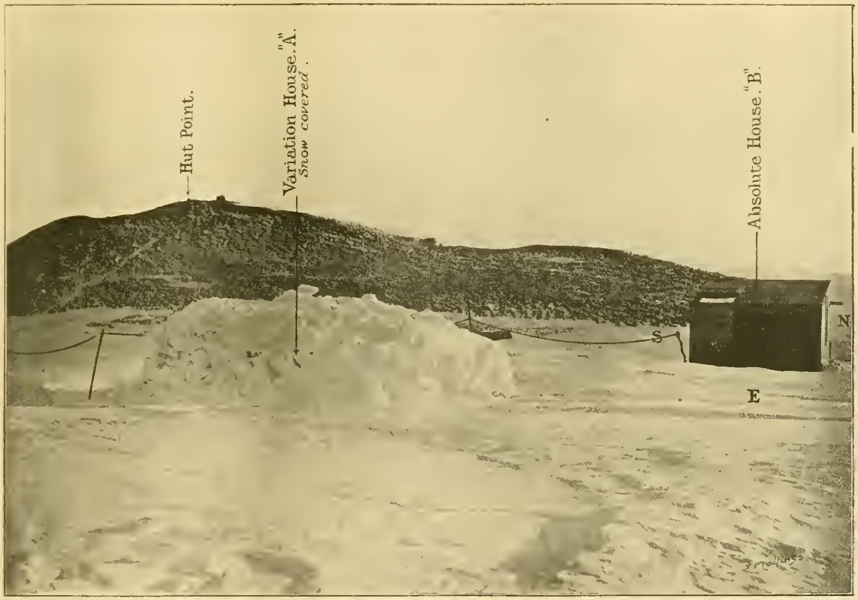
THE series of volumes now being issued by the Royal Society detailing the scientific observations made in the course of the *Discovery* expedition should impress upon the public the extent and variety of the problems that are under consideration, as well as inform them of the degree of success that has attended the efforts of those who have had to make the observations in trying circumstances. Many, unfortunately, fail to grasp the real object of such

[1] "Physical Observations, with Discussions by Various Authors." Prepared under the superintendence of the Royal Society. Pp. v+192. (London: Publish d by the Royal Society, 1908.)

expeditions, since an approach towards the Pole has acquired so much significance in popular estimation. An examination of the present volume, however, is calculated to offer a wider view with truer perspective. In it are presented the results of only a portion of the physical observations, those having reference to tides, pendulum experiments, earthquakes, and auroral and magnetic phenomena. Following the plan adopted in the meteorological observations, the Royal Society has placed the preparation of the reports on these subjects in the hands of authorities most competent to deal with them.

The tidal observations, extending from May 12, 1902, to September 20, 1903, have been discussed by Sir G. H. Darwin, who remarks that though the tidal constants derived by harmonic analysis may not be sufficiently accurate to give the means of constructing a tide-table for Ross Island, they are sufficiently trustworthy to afford an insight into the nature of Antarctic tides. The sum of the semi-ranges of the three principal diurnal tides amounts to 21·6 inches, and of the three semi-diurnal tides to 3·4 inches, consequently the effect of the semi-diurnal tides is scarcely noticeable on a simple inspection of the tidal curves; but a further investigation shows that the semi-diurnal tide exhibits a progressive change both in amplitude and phase as the season advances. The cause of this change it is not easy to determine, since there is no astronomical tide that can give an annual inequality in the semi-diurnal tide of sufficient amount to account for the perturbation. The tidal observations made in the *Scotia* have been reduced by Messrs. Selby and Hunter, of the National Physical Laboratory, and have been incorporated in this volume. The tides in the South Orkneys, the *Scotia* station, are normal for a place in the Southern Ocean. The semi-diurnal tides are considerable, and the solar tide is large in comparison with the lunar tide, the ratio being 0·6, as against 0·465 required by the equilibrium theory.

The pendulum observations, made on several occasions at the winter quarters, have been discussed by Dr. Chree, who regrets that a trained physical observer did not accompany the expedition, but gratefully acknowledges the readiness with which Messrs. Bernacchi and Skelton undertook the necessary work of mounting the instruments, and the care with which they carried out the observations. These observers exhibited remarkable skill and ingenuity in overcoming difficulties connected with the apparatus, and what value the observations possess is due to the patience and devotion of these officers. The mean observed value of gravity is slightly in excess of the theoretical, and similar results have been obtained by other observers in the Australian continent. There is, too, a considerable discrepancy between the results obtained at the winter quarters in February and in September, the explanation of which it is not easy to see, as the temperature and pressure were nearly the same. Mr. Bernacchi is inclined to attribute this difference to the large northward movement of ice in the Antarctic summer prior to February. Dr. Chree quotes this opinion without endorsing it.



National Antarctic Expedition: View of Magnetic Houses at Winter Quarters. From "Physical Observations."

The earthquake records discussed by Prof. Milne disclose the existence of a centre of seismic activity situated to the south of New Zealand, no fewer than 136 earthquakes having been recorded in the twenty-one months the apparatus was at work. The most interesting feature in the discussion has been to confirm a suspicion that Prof. Milne entertained, that earthquake shocks could reappear at antipodal stations without being recorded at intermediate positions. New Zealand being nearly at our antipodes, he had noticed that many earthquakes having their origin in or near that colony were registered at English stations, particularly at Bidston, without disturbing the instruments at observatories remote from that diameter. Prof. Milne remarks that he has met with a number of instances "where the movement from an epifocal area has travelled round and through the world to reappear as a recordable quantity at its antipodes."

The pictures of the aurora reproduced from the drawings of Dr. Wilson are very striking, but Mr. Bernacchi remarks that though the phenomenon is frequent the dis-

play is not brilliant. The light is comparable with that of the Milky Way, and the moonlight between the first and third quarters is usually sufficient to overcome that of the aurora. Owing to this feeble light, the spectroscopic observations were not successful. On some occasions the characteristic yellow line near D was seen in a direct-vision spectroscope, but no record was obtained by photography, though plates were exposed from a few minutes to twenty-four hours and longer.

In the last section Commander Chetwynd and Dr. Chree discuss the results of the magnetic observations. One interesting result is the determination of the position of the south magnetic pole by the method of observed declinations and inclinations. The results are as follows:—

By declination ...	72° 50′ S. lat. ...	156° 20′ E. long.
,, incl nation ...	72° 52′ ,, ...	156° 30′ ,,

The close agreement is curious and eminently satisfactory.

THE NORTH OF ENGLAND EDUCATION CONFERENCE.

THE seventh annual meeting of the above conference was held at Manchester during the latter half of last week, January 7–9. The meeting was very well attended, and the arrangements for social intercourse and general comfort were excellent. There was a conversazione on Thursday evening at the Municipal School of Technology, and a reception at the Town Hall on Friday evening. A convenient handbook was issued containing a full programme.

The actual work of the conference began on Friday, when the president, the Right Rev. Bishop Welldon, Dean of Manchester, delivered his presidential address. He put great stress on the fact that everything in education depends ultimately on the teacher, who cannot be too highly trained; but the success of education depends also on the completeness with which the good scholar can ascend the educational ladder right up to the university. The ultimate aim of all educational efforts is "to fit the young, young men and women alike, to be good husbands and wives, good parents of families, good citizens."

In his address on "The Incidence of the Cost of Education," Lord Stanley of Alderley appealed for more Government aid in the shape of money, and he suggested that a Royal Commission should be appointed in order to inquire into the cost of education. He maintained, in any case, that a large share of the cost should be borne locally by the levying of rates, whereas Alderman Oulton (Liverpool) was rather in favour of increased taxation for educational purposes. There was general agreement on one point—that more money is necessary. It is to be hoped that this suggestion made during the conference on the question of increased financial aid will bear fruit in some form or other. We want to get the best men and women into the teaching profession. They must be well trained, and should be able to expect a reasonably adequate return for the expense of their training and education. The building of modern schools and their outfitting of course also cost money, and every teacher knows how much better he can teach in a good and well equipped than in a poorly furnished and badly lighted and ventilated classroom.

In the afternoon "The Supply of Teachers" was under discussion. It appears that the supply far exceeds the demand at present, but that circumstances should be made use of to weed out inefficient teachers and replace them by better ones. "The Teaching of Languages" and "The Training of Girls in Domestic Subjects" also came in for debate during the afternoon. In the former, Prof. Sonnenschein appeared as the champion of Latin, though not to the exclusion of German and French. French might even be taken at school before Latin. In the latter, Miss Margaret Ashton argued that it would not be right that girls and boys should be educated entirely on the same lines.

On Saturday, at the general meeting, "The Coordination of the Curricula in Primary and Secondary Schools" formed the subject of a paper by Mr. Paton (Manchester Grammar School). He maintained that the teaching of science is adequately cared for in the school curricula, but that there is a lack of continuity in the teaching of classics. He mentioned the fact that at the present day most members of the Church, of the Civil Services, of the journalistic and diplomatic professions have been through mainly a classical education; and he held that therefore more attention should be paid to classical education. Most men of science, however, would arrive at the opposite conclusion. Reference may here be made to some remarks made by Lord Fitzmaurice at a recent Royal Society dinner, and quoted by Sir E. Ray Lankester in one of his essays "From an Easy Chair." "It is every day becoming more and more certain that science is the master." Lord Fitzmaurice further said that at no distant date it may be considered not only reasonable, but necessary, to replace the present-day diplomatists by men of science.

We must always remember, however, that the teaching of science at school is still a comparatively recent development. We are not only still learning and experimenting how to teach the subject as well or better than the ancient languages are taught, but we have to contend against a great deal of traditional, and perhaps not unnatural, prejudice.

In the afternoon a powerful plea was put in for the evening instruction of the so-called "masses." There is no doubt that there are really a very large number of men and women workers willing to improve their minds, not only along technical, but also along purely academic lines; but this can only to a limited extent be done by the provision of evening courses. A university degree based on an "evening-class" knowledge cannot, on the average, be so well earned as a degree depending on day work. The idea of giving full university degrees on the strength of evening work should not be encouraged; but everything should be done by universities to encourage the attendance of day workers as students at evening classes in order to cultivate their minds, without any intention of taking a degree. Scholarships obtained at evening courses might then lead on to day courses.

A detailed discussion on the subject of "Methods of Teaching Mathematics" concluded the business of the conference on Saturday afternoon. On this occasion the two chief papers were read by Mr. Garstang (Bedales School, Petersfield) and Mr. Brotherton (School of Technology, Manchester).

THE ÆTHER OF SPACE.[1]

THIRTY years ago Clerk Maxwell gave in this place a remarkable address on "Action at a Distance." It is reported in the Journal of the institution, vol. vii., and to it I would direct attention. Most natural philosophers hold, and have held, that action at a distance across empty space is impossible; in other words, that matter cannot act where it is not, but only where it is. The question, "Where is it?" is a further question that may demand attention and require more than a superficial answer. For it can be argued on the hydrodynamic or vortex theory of matter, as well as on the electrical theory, that every atom of matter has a universal, though nearly infinitesimal, prevalence, and extends everywhere, since there is no definite sharp boundary or limiting periphery to the region disturbed by its existence. The lines of force of an isolated electric charge extend throughout illimitable space; and though a charge of opposite sign will curve and concentrate them, yet it is possible to deal with both charges, by the method of superposition, as if they each existed separately without the other. In that case, therefore, however far they reach, such nuclei clearly exert no "action at a distance" in the technical sense.

Some philosophers have reason to suppose that mind can act directly on mind without intervening mechanism, and sometimes that has been spoken of as genuine action at a distance; but, in the first place, no proper conception or physical model can be made of such a process, nor is it clear that space and distance have any particular meaning in the region of psychology. The links between mind and mind may be something quite other than

[1] Abstract of discourse delivered at the Royal Institution on February 21, 1908, by Sir Oliver Lodge, F.R.S.

physical proximity, and in denying action at a distance across empty space I am not denying telepathy or other activities of a non-physical kind; for although brain disturbance is certainly physical and is an essential concomitant of mental action, whether of the sending or receiving variety, yet we know from the case of heat that a material movement can be excited in one place at the expense of corresponding movement in another, without any similar kind of transmission or material connection between the two places; the thing that travels across vacuum is not heat.

In all cases where physical motion is involved, however, I would have a medium sought for; it may not be matter, but it must be something; there must be a connecting link of some kind, or the transference cannot occur. There can be no attraction across really empty space; and even when a material link exists, so that the connection is obvious, the explanation is not complete, for when the mechanism of attraction is understood it will be found that a body really only moves because it is pushed by something from behind. The essential force in nature is the *vis a tergo*. So when we have found the "traces," or discovered the connecting thread, we still run up against the word "cohesion," and ought to be exercised in our minds as to its ultimate meaning. Why the whole of a rod should follow, when one end is pulled, is a matter requiring explanation; and the only explanation that can be given involves, in some form or other, a continuous medium connecting the discrete and separated particles or atoms of matter.

When a steel spring is bent or distorted, what is it that is really strained? Not the atoms—the atoms are only displaced; it is the connecting links that are strained—the connecting medium—the æther. Distortion of a spring is really distortion of the æther. All stress exists in the æther. Matter can only be moved. Contact does not exist between the atoms of matter as we know them; it is doubtful if a piece of matter ever touches another piece, any more than a comet touches the sun when it appears to rebound from it; but the atoms are connected, as the comet and the sun are connected, by a continuous *plenum* without break or discontinuity of any kind. Matter acts on matter only through the æther. But whether matter is a thing utterly distinct and separate from the æther, or whether it is a specifically modified portion of it—modified in such a way as to be susceptible of locomotion, and yet continuous with all the rest of the æther, which can be said to extend everywhere—far beyond the bounds of the modified and tangible portion—are questions demanding, and I may say in process of receiving, answers.

Every such answer involves some view of the universal and possibly infinite uniform omnipresent connecting medium, the æther of space.

It has been said, somewhat sarcastically, that the æther was made in England. The statement is only an exaggeration of the truth. I might even urge that it has been largely constructed in the Royal Institution, for I will remind you now of the chief lines of evidence on which its existence is believed in, and our knowledge of it is based. First of all, Newton recognised the need of a medium for explaining gravitation. In his "Optical Queries" he shows that if the pressure of this medium is less in the neighbourhood of dense bodies than at great distances from them, dense bodies will be driven towards each other, and that if the diminution of pressure is inversely as the distance from the dense body, the law will be that of gravitation.

All that is required, therefore, to explain gravity is a diminution of pressure, or increase of tension, caused by the formation of a matter unit—that is to say, of an electron or corpuscle; and although we do not yet know what an electron is—whether it be a strain centre, or what kind of singularity in the æther it may be—there is no difficulty in supposing that a slight, almost infinitesimal strain or attempted rarefaction should be produced in the æther whenever an electron came into being, to be relaxed again only on its resolution and destruction. Strictly speaking, it is not a real *strain*, but only a "stress," since there can be no actual *yield*, but only a pull or tension, extending in all directions towards infinity.

The tension required per unit of matter is almost ludicrously small, and yet in the aggregate, near such a body as a planet, it becomes enormous.

The force with which the moon is held in its orbit would be great enough to tear asunder a steel rod four hundred miles thick, with a tenacity of thirty tons per square inch, so that if the moon and earth were connected by steel instead of by gravity, a forest of pillars would be necessary to whirl the system once a month round their common centre of gravity. Such a force necessarily implies enormous tension or pressure in the medium. Maxwell calculates that the gravitational stress near the earth, which we must suppose to exist in the invisible medium, is 3000 times greater than what the strongest steel could stand, and near the sun it should be 2500 times as great as that.

The question has arisen in my mind whether, if the whole sensible universe—estimated by Lord Kelvin as equivalent to about a thousand million suns—were all concentrated in one body of specifiable density,[1] the stress would not be so great as to produce a tendency towards ethereal disruption, which would result in a disintegrating explosion and a scattering of the particles once more as an enormous nebula and other fragments into the depths of space; for the tension would be a maximum in the interior of such a mass, and, if it rose to the value 10^{33} dynes per square centimetre, something would have to happen. I do not suppose that this can be the reason, but one would think there must be *some* reason for the scattered condition of gravitative matter.

Too little is known, however, about the mechanism of gravitation to enable us to adduce it as the strongest argument in support of the existence of an æther. The oldest valid and conclusive requisition of an ethereal medium depends on the wave theory of light, one of the founders of which was your professor of natural philosophy at the beginning of last century, Dr. Thomas Young.

No ordinary matter is capable of transmitting the undulations or tremors that we call light. The speed at which they go, the kind of undulation, and the facility with which they go through vacuum forbid this.

So clearly and universally has it been perceived that waves must be waves of something—something distinct from ordinary matter—that Lord Salisbury, in his presidential address to the British Association at Oxford, criticised the æther as little more than a nominative case to the verb to undulate. It is truly *that*, though it is also truly more than that; but to illustrate that luminiferous aspect of it, I will quote a paragraph from that lecture of Clerk Maxwell's to which I have already alluded:—

"The vast interplanetary and interstellar regions will no longer be regarded as waste places in the universe, which the Creator has not seen fit to fill with the symbols of the manifold order of His kingdom. We shall find them to be already full of this wonderful medium; so full, that no human power can remove it from the smallest portion of space, or produce the slightest flaw in its infinite continuity. It extends unbroken from star to star; and when a molecule of hydrogen vibrates in the Dog-star, the medium receives the impulses of these vibrations, and after carrying them in its immense bosom for several years, delivers them, in due course, regular order, and full tale, into the spectroscope of Mr. Huggins, at Tulse Hill." (It is pleasant to remember that those veteran investigators Sir William and Lady Huggins are still at work.)

This will suffice to emphasise the fact that the eye is truly an ethereal sense-organ—the only one which we possess, the only mode by which the æther is enabled to appeal to us, and that the detection of tremors in this medium—the perception of the direction in which they go, and some inference as to the quality of the object which has emitted them—cover all that we mean by "sight" and "seeing."

I pass, then, to another function, the electric and magnetic phenomena displayed by the æther, and on this I will only permit myself a very short quotation from the

1 On doing the Arithmetic, however, I find the necessary concentration absurdly great, showing that such a mass is quite insufficient.

writings of Faraday, whose whole life may be said to have been directed towards a better understanding of these ethereous phenomena. Indeed, the statue in your entrance hall may be considered as the statue of the discoverer of the electric and magnetic properties of the æther of space.

Faraday conjectured that the same medium which is concerned in the propagation of light might also be the agent in electromagnetic phenomena. "For my own part," he says, "considering the relation of a vacuum to the magnetic force, and the general character of magnetic phenomena external to the magnet, I am much more inclined to the notion that in the transmission of the force there is such an action, external to the magnet, than that the effects are merely attraction and repulsion at a distance. Such an action may be a function of the æther; for it is not unlikely that, if there be an æther, it should have other uses than simply the conveyance of radiation."

This conjecture has been amply strengthened by subsequent investigations.

One more function is now being discovered; the æther is being found to constitute matter—an immensely interesting topic, on which there are many active workers at the present time. I will make a brief quotation from your present professor of natural philosophy (J. J. Thomson), where he summarises the conclusion which we all see looming before us, though it has not yet been completely attained, and would not by all be similarly expressed:—

"The *whole* mass of any body is just the mass of æther surrounding the body which is carried along by the Faraday tubes associated with the atoms of the body. In fact, all mass is mass of the æther; all momentum, momentum of the æther; and all kinetic energy, kinetic energy of the æther. This view, it should be said, requires the density of the æther to be immensely greater than that of any known substance."

Yes, far denser—so dense that matter by comparison is like gossamer, or a filmy, imperceptible mist, or a Milky Way. Not unreal or unimportant—a cobweb is not unreal, nor to certain creatures is it unimportant, but it cannot be said to be massive or dense; and matter, even platinum, is not dense when compared with the æther. Not until last year, however, did I realise what the density of the æther must really be,[1] compared with that modification of it which appeals to our senses as matter, and which for that reason engrosses our attention. If I have time I will return to that before I have finished.

Is there any other function possessed by the æther which, though not yet discovered, may lie within the bounds of possibility for future discovery? I believe there is, but it is too speculative to refer to, beyond saying that it has been urged as probable by the authors of "The Unseen Universe," and has been thus tentatively referred to by Clerk Maxwell:—

"Whether this vast homogeneous expanse of isotropic matter is fitted not only to be a medium of physical interaction between distant bodies, and to fulfil other physical functions of which, perhaps, we have as yet no conception, but also . . . to constitute the material organism of beings exercising functions of life and mind as high or higher than ours are at present—is a question far transcending the limits of physical speculation."

And there, for the present, I leave that aspect of the subject.

I shall now attempt to illustrate some relations between æther and matter.

The question is often asked, Is æther material? This is largely a question of words and convenience. Undoubtedly the æther belongs to the material or physical universe, but it is not ordinary matter. I should prefer to say it is not "matter" at all. It may be the substance or substratum or material of which matter is composed, but it would be confusing and inconvenient not to be able to discriminate between matter, on the one hand, and æther on the other. If you tie a knot on a bit of string, the knot is composed of string, but the string is not composed of knots. If you have a smoke or vortex-ring in the air, the vortex-ring is made of air, but the atmosphere is not a vortex-ring, and it would be only confusing to say that it was.

[1] See Lodge, *Phil. Mag.*, April, 1907.

The essential distinction between matter and æther is that matter *moves*, in the sense that it has the property of locomotion and can effect impact and bombardment, while æther is *strained*, and has the property of exerting stress and recoil. All potential energy exists in the æther. It may vibrate, and it may rotate, but as regards locomotion it is stationary—the most stationary body we know—absolutely stationary, so to speak; our standard of rest.

All that we ourselves can effect, in the material universe, is to alter the motion and configuration of masses of matter; we can move matter by our muscles, and that is all we can do directly; everything else is indirect.

But now comes the question, How is it possible for matter to be composed of æther? How is it possible for a solid to be made out of fluid? A solid possesses the properties of rigidity, impenetrability, elasticity, and such like; how can these be imitated by a perfect fluid such as the æther must be? The answer is, they can be imitated by a fluid in motion, a statement which we make with confidence as the result of a great part of Lord Kelvin's work.

It may be illustrated by a few experiments.

A wheel of spokes, transparent or permeable when stationary, becomes opaque when revolving, so that a ball thrown against it does not go through, but rebounds. The motion only affects permeability to matter; transparency to light is unaffected, until something near the speed of light itself is reached.

A silk cord hanging from a pulley becomes rigid and viscous when put into rapid motion, and pulses or waves which may be generated on the cord travel along it with a speed equal to its own velocity, whatever that velocity may be, so that they appear to stand still. This is a case of kinetic rigidity, and the fact that the wave-transmission velocity is equal to the rotatory speed of the material is typical and important, for in all cases of kinetic elasticity these two velocities are of the same order of magnitude.

A flexible chain, set spinning, can stand up on end while the motion continues.

A jet of water at sufficient speed can be struck with a hammer, and resists being cut with a sword.

A spinning disc of paper becomes elastic, like flexible metal, and can act like a circular saw. Sir William White tells me that in naval construction steel plates are cut by a rapidly revolving disc of soft iron.

A vortex-ring, ejected from an elliptical orifice, oscillates about the stable circular form, as an india-rubber ring would do, thus furnishing a beautiful example of kinetic elasticity, and showing us clearly a fluid displaying some of the properties of a solid.

A still further example is Lord Kelvin's model of a spring balance, made of nothing but rigid bodies in spinning motion.[1]

If the æther can be set spinning, therefore, we may have some hope of making it imitate the properties of matter, or even of constructing matter by its aid. But how are we to spin the æther? Matter alone seems to have no grip of it. I have spun steel discs, a yard in diameter, 4000 times a minute, have sent light round and round between them, and tested carefully for the slightest effect on the æther. Not the slightest effect was perceptible. We cannot spin æther mechanically.

But we can vibrate it electrically, and every source of radiation does that. An electrified body, in sufficiently rapid vibration, is the only source of æther-waves that we know, and if an electric charge is suddenly stopped it generates the pulses known as X-rays, as the result of the collision. Not speed, but sudden change of speed, is the necessary condition for generating waves in the æther by electricity.

We can also infer some kind of rotary motion in the æther, though we have no such obvious means of detecting the spin as is furnished by vision for detecting some kinds of vibration. It is supposed to exist whenever we put a charge into the neighbourhood of a magnetic pole. Round the line joining the two the æther is spinning like a top. I do not say it is spinning fast: that is a question of its density; it is, in fact, spinning with excessive slowness, but it is spinning with a definite moment of momentum.

[1] Address to Section A of British Association at Montreal, 1884.

J. J. Thomson's theory makes its moment of momentum exactly equal to *em*, the product of charge and pole, the charge being measured electrostatically and the pole magnetically.

How can this be shown experimentally? Suppose we had a spinning top enclosed in a case, so that the spin was unrecognisable by ordinary means—it could be detected by its gyrostatic behaviour to force. If allowed to "precess" it will respond by moving perpendicularly to a deflecting force. So it is with the charge and the magnetic pole. Try to move the charge suddenly, and it immediately sets off at right angles. A moving charge is a current, and the pole and the current try to revolve round one another—a true gyrostatic action due to the otherwise unrecognisable ethereal spin. The fact of such magnetic rotation was discovered by Faraday.

I know that it is usually worked out in another way, in terms of lines of force and the rest of the circuit; but I am thinking of a current as a stream of projected charges, and no one way of regarding such a matter is likely to exhaust the truth or to exclude other modes which are equally valid. Anyhow, in whatever way it is regarded, it is an example of the three rectangular vectors.

The three vectors at right angles to each other, which may be labelled current, magnetism, and motion respectively, or more generally E, H, and V, represent the quite fundamental relation between æther and matter, and constitute the link between electricity, magnetism, and mechanics. Where any two of these are present, the third is a necessary consequence. This principle is the basis of all dynamos, of electric motors, of light, of telegraphy, and of most other things. Indeed, it is a question whether it does not underlie everything that we know in the whole of the physical sciences, and whether it is not the basis of our conception of the three dimensions of space.

Lastly, we have the fundamental property of matter called *inertia*, which, if I had time, I would show could be explained electromagnetically, provided the ethereal density is granted as of the order 10^{12} grams per cubic centimetre. The elasticity of the æther would then have to be of the order 10^{33} C.G.S., and if this is due to intrinsic turbulence, the speed of the whirling or rotational elasticity must be of the same order as the velocity of light. This follows hydrodynamically, in the same sort of way as the speed at which a pulse travels on a flexible running endless cord, the tension of which is entirely due to the centrifugal force of the motion, is precisely equal to the velocity of the cord itself; and so, on our present view, the intrinsic energy of constitution of the æther is incredibly and portentously great, every cubic millimetre of space possessing what, if it were matter, would be a mass of a thousand tons, and an energy equivalent to the output of a million-horse-power-station for forty million years.

The universe we are living in is an extraordinary one, and our investigation of it has only just begun. We know that matter has a psychical significance, since it can constitute *brain*, which links together the physical and the psychical worlds. If anyone thinks that the æther, with all its massiveness and energy, has probably no psychical significance, I find myself unable to agree with him.

SCIENCE AND THE PRACTICAL PROBLEMS OF THE FUTURE.[1]

AT the recent conference on the conservation of resources which met at the White House at the invitation of the President of the United States, notes of warning were sounded concerning the coming exhaustion of coal, wood, ores, and soils. Whether or not we accept as exact the estimates furnished by experts on that impressive occasion, there is no doubt that we are approaching the end of our available resources, and that the near future will have momentous problems to face.

Certain things are clear.

First.—Unchecked wastefulness as exhibited, for example, in the extermination of the bison, in the destruction of forests, in the exhaustion of the soil, in the disappearance from our coasts and streams, that once teemed with fish, of this important source of food supply, in the pouring into the air of an incredible amount of unused fuel from hundreds of thousands of coke ovens, must cease, or our ruthless exploitation will bring disaster on generations soon to come. The prevention of these and countless other manifestations of individual and corporate greed is a problem for the economist and the law-maker, although they will scarcely succeed in its solution without calling science to their aid.

Second.—Saving and thrift offer at best only a postponement of the day of distress. The end of our supplies of coal and petroleum must ultimately be reached. Forests may be renewed and the soil restored to its maximum fertility, but the problem which is presently to confront the race is that of civilised existence without recourse to energy stored by the slow processes of nature. This problem must be definitely solved before the complete exhaustion of our inherited capital.

Third.—The problem is not without conceivable solution, since the annual accession of energy from the sun, did we know how to utilise it without awaiting the slow processes of storage employed by nature, is ample for every thinkable need of the future inhabitants of our planet. Estimates of the constant of solar radiation show that about 2·18 kilowatts of power is continually received from the sun for every square metre of the earth's surface, or more than seven and a half millions of horse-power per square mile. The present use of power in the United States is about eighty million horse-power, or one horse-power per capita. This quantity is likely to increase more rapidly than the population in the future unless curtailed by lack of fuel, but it is evident that a very small fraction of the sun's radiation would meet all demands.

Now abundant power is soon to be the factor upon which material advancement will chiefly depend. To obtain it in the face of the disappearance of coal and petroleum will be imperative. For success in this, upon which in the immediate future the welfare of the race and ultimately its very perpetuity is to depend, we must look to science. Mere ingenuity or inventiveness, however widely developed, will not suffice. The inventor and the engineer can but utilise and apply the material which the man of science provides, and with the exhaustion of our stores of scientific knowledge civilisation must halt.

It is of this fundamental relation of science to the progress of our civilisation that I wish to speak. The fact that material progress is based upon science seems to be but dimly understood. It appears to be generally supposed that it is to the inventor and to those who use his devices that we owe our present advantages over our forefathers. I would not belittle the achievements of the so-called practical man, but the public must be taught that application can never run ahead of the knowledge to be applied, and that the only road to higher achievement in practical things is by the further development of pure science.

The *main product* of science, using that word in its broadest sense, is *knowledge*; among its by-products are the technological arts, including invention, engineering in all its branches, and modern industry. Not all industries have attained the character of a technological art. Burning the woods to drive out game, and thus obtain a dinner, is a form of industry. Like it in character are some very large industries, such as agriculture of the sort that impoverishes the soil; lumbering that destroys forests, and incidentally ruins rivers and increases erosion; coke-making by processes that waste 40 per cent. of the energy of coal. The production of power from coal by means of the steam boiler and the reciprocating engine we at present regard as a highly developed technological art; yet it is a process which, at the very best, converts less than 10 per cent. of the total stored energy of the fuel into available form. If the ultimate purpose of this power is the production of light, we by our present methods suffer a second waste of 90 per cent. or more, so that the efficiency of the combined processes is but a fraction of 1 per cent. These things are excusable while ignorance lasts. They become criminal with realisation of the results, and are inconceivable in a community of fully developed civilisation. Science paves the way for the gradual sup-

[1] Abridged from the address delivered by Prof. E. L. Nichols, the retiring president of the American Association for the Advancement of Science, at the Baltimore meeting, December, 1908.

planting of these barbarous methods by more refined and rational processes, but they often persist long after they are known to be injurious to the public welfare because they happen to serve some selfish individual or corporate purpose. In such cases it is to science again that we must look for the development of an enlightened public opinion that will end them.

A country that has many investigators will have many inventors also. A scientific atmosphere dense enough to permeate the masses brings proper suggestions to many practically inclined minds. Where science is there will its by-product, technology, be also. Communities having the most thorough fundamental knowledge of pure science will show the greatest output of really practical inventions. Peoples who get their knowledge at second-hand must be content to follow. Where sound scientific conceptions are the common property of a nation, the wasteful efforts of the half-informed will be least prevalent. The search after perpetual motion, the attempt to evade the second law of thermodynamics, and the promotion of the impracticable are all simply symptoms of a people's ignorance.

Modern invention is a very near neighbour to the pure science of the laboratory, and the relation becomes daily more intimate. Nothing could apparently be more academic in its early development or further from the practical workaday world than the subject of electric waves. For years it was regarded as a fine field for the speculations of the mathematical physicist. Then at the hands of Hertz and his followers it became a fascinating topic for experimental investigation by men devoted to science for its own sake. Suddenly it was launched into the realm of hard-headed commercialism by a practical man, daring, enthusiastic, and optimistic enough, at a time when electric waves could be produced in one room of the laboratory and detected in the next room, to dream of sending such waves across the sea as bearers of human messages.

At every step of its development the things that have made wireless telegraphy possible have been borrowed from pure science.

While Marconi was still struggling to adapt the apparatus of Righi to long-distance transmission, the antenna and the coherer were already in use by Popoff in the study of oscillatory lightning. In the thermal detector of Fessenden the almost invisible platinum wires produced years before by Wollaston for the cross-hairs of telescopes appear in a new field of usefulness. The "lead-tree" familiar as a simple and beautiful lecture experiment in electrolysis forms the basis of the responder of De Forrest. Another form of electrolytic detector, introduced independently as the receiver of wireless signals by Schloemilch and by Vreeland, traces back to the Wehnelt interrupter. Marconi's latest receiver, the magnetic detector, is an ingenious modification of Rutherford's device for the study of electric waves, and this in turn was based on the classical experiment of Joseph Henry on the effects of the discharge of Leyden jars on the magnetisation of steel sewing needles.

It is needless to multiply examples. In the history of science and of invention this intimate relation appears to be almost universal. The environment of science has always been academic. Science has its home in the university. From Galileo and Newton to our own time the men who have laid the foundations upon which civilisation is built have nearly all been teachers and professors.

A few notable exceptions there are, such as Darwin, whose centenary we are about to celebrate. Each branch has its short list of unattached investigators—Franklin, Rumford, Carnot, Joule in physics, &c.—but the honour-roll of science is essentially an academic list.

It is necessary, in considering the place of America in science, to contrast the standing of its educational institutions, not pedagogically, but as centres of research, with those of other countries. The United States has less than its share of men of science, because it has not, as yet, universities that sufficiently foster and encourage research. When in any of its institutions a man distinguishes himself by productive work, he is frequently made a dean, director, or even president, and is thus retired from what might have been a great career as an investigator. Thereafter he is compelled to devote himself to administrative duties, which someone not equipped for the important task of adding to the world's stock of knowledge might just as well perform. It is as though the authorities were to say, X has written an admirable book, we must appoint him book-keeper; or Y is developing a decided genius for landscape, we will increase his salary and ask him to devote all his time to painting the woodwork of the university buildings. Nor does the mischief stop with the sacrifice of a few bright spirits. It extends to the bottom. The head of each department is a petty dean, cumbered with administrative detail. He is expected to hold everyone under him to account, not for scholarly productiveness, but for the things which chiefly hinder it.

In this exaltation of administrative ability over creative gifts, which are much rarer and more precious, our institutions share the weakness which pervades our industrial establishments, where the manager or superintendent usually gets larger pay and is regarded as more important than the most expert craftsman. In both we see the same striving for a certain sort of efficiency and economy of operation and for the attainment of a completely standardised product. This tends in both cases to the elimination of individuality and to sterility. In the university it retards instead of developing research. In industry it discourages originality. I would that there might be displayed in the administrative offices of every institution of higher education this testy remark, once made by an eminent scholar:—"*You cannot run a university as you would a saw-mill!*"

If anyone questions the responsibility of the American university for the shortcomings of American science, and is inclined to seek some more obscure cause for the conditions that I have endeavoured to portray, let him consider the history of astronomy in the United States. This science, for some reason, was from the first accorded favours not vouchsafed to any other branch of learning. Colleges that made no pretence of research, and had neither laboratories nor libraries worthy of the name, were ambitious to have observatories, and rich men were found to establish and endow them. The observatory implied, somehow, to the minds of the authorities an astronomer —not merely someone of good moral character who could teach the subject—and so it came about that there was one member of the college faculty who was expected to do scientific work, and was left comparatively free to observe and investigate. Modest as most of these early provisions for astronomy were, they bore fruit, and American astronomy gained standing and recognition while her sister sciences were struggling for existence. Later, it is true, there arose an ambition for laboratories, and there were laboratories; but, unfortunately, save in very rare instances, the laboratory has not implied an investigator. The conditions which made astronomy what it was have not been repeated. Productiveness has not been demanded nor expected; neither have the inmates of our laboratories been accorded that exemption from excessive pedagogical duties which would enable them to give their best strength to research.

A recent event in the educational world well illustrates the weakness of our academic attitude toward science. The head of one of our strongest, most modern, most progressive, and best equipped institutions has announced, as one of the details of a noble bequest to the University, the endowment of ten research professorships. President Van Hise declares:—

"The provisions for their support, including liberal salaries, assistants, materials, a limited amount of instructional work, and relations with students, are an epitome of the situation in the best German universities, which are admitted to stand first among the institutions of the world in the advancement of knowledge."

This is indeed an event to warm the heart of everyone who is interested in the promotion of science. All who are devoted to learning for its own sake or who realise the importance of science to the welfare of the nation will applaud that portion of the will in which this great gift is made, which reads:—

"The university may best be raised to the highest excellence as a seat of learning and education by abundant support in pushing the confines of knowledge."

Yet in very truth there is nothing to prevent the University of Wisconsin, or any other of a hundred like institutions, without awaiting the rare advent of some far-sighted benefactor, from having, not ten, but all her professorships made research professorships—nothing, alas, but the deep-seated and seemingly uneradicable conviction of the boards of control, that the endowments committed to their charge are for some other purpose.

A true university from the point of view of scientific productiveness is a body of scholars, that is to say, of men devoting themselves solely to the advancement of learning. Everyone in it, from top to bottom, should be an investigator. The entire income of a university should be expended in the promotion of science, *i.e.* of knowledge. Teaching is a necessary factor in the advancement of learning, and so a function of the university. University teaching should be done by investigators, not only because more investigators are to be developed, but because the promotion of science, on the scale which the future demands, means that science shall not remain narrowly academic, but shall more and more pervade the life of the people.

From the point of view of American institutions such a definition of the university is revolutionary, but it cannot be said to be impracticable or Utopian, for upon precisely such ideals the most successful university systems in the world have been built.

That this type will bear transplanting to American soil was triumphantly demonstrated in the work of Daniel C. Gilman, who gave the Johns Hopkins University at its inception the essential characteristics of the German universities as regards research. This successful experiment should have marked an epoch in the history of higher education, but a generation has passed and we have not as yet a university system devoted primarily to the advancement of learning. We still consider investigation merely as a desirable adjunct to university activities, never as the thing for which the university exists.

Germany, on the other hand, has for a century consistently developed the university as a centre of research, and through the promotion of pure science in the university has made German civilisation what it is to-day.

I would not be understood as urging German or other European methods in all details upon a country where quite different conditions exist, but one general principle is of universal application. In whatever we have to do, whether it be municipal administration, sanitation, road-making, the construction of water-ways, the development of industries, or the conservation of natural resources, the fullest and latest scientific knowledge should be utilised. Practice should not be permitted to lag indefinitely behind theory, and that they may go hand in hand public work and private enterprises should be in the hands of *those who know*. At the same time, science should be persistently advanced by every possible agency.

To my mind, the future of science in America, as elsewhere, is essentially a question of the future of the universities. It is conceivable that institutions may so long continue blind to their chief function as to be supplanted by some new agency called into existence to take up their neglected work. Already great endowments for the promotion of research, quite without any pedagogical feature, have come into existence. For all such science has need, and will have increasing need, as the situation becomes more acute and we are brought closer to the great crisis.

But it will be found that the conditions for maximum scientific productiveness are precisely those which would exist in the ideal university. All attempts at a machine-made science are doomed to failure. Science-making syndicates are likely to meet shipwreck on the very rocks on which the American educational system is already aground. No autocratic organisation is favourable to the development of the scientific spirit. No institution after the commercial models of to-day is likely to be generously fertile. You can contract for a bridge according to specifications. If a railway is to be built and operated, a highly organised staff with superintendents and foremen and an elaborate system reaching every detail may be made to yield the desired results. No one, however, can draw up specifications for a scientific discovery. No one can contract to deliver it on a specified day for a specified price. No employee can be hired to produce it in return for wages received.

To the investigator the considerations I have endeavoured to present are unimportant. Science for its own sake is his sufficient incentive; but it is all-important for the community at large to realise that no real addition to knowledge is useless or trivial; that progress depends on scientific productiveness; that science, which must be fostered if we are to continue to prosper, is a republic the watchwords of which are *liberty, equality, fraternity*.

World power in the near future is to be a question of knowledge—not of battleships—and what is now spent on armaments is to be devoted to its pursuit. Beyond lies that future in which it will no longer be a question of supremacy among nations, but of whether the race is to maintain its foothold on the earth.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

To perpetuate the memory of the late Sir George Livesey it is proposed to endow a Livesey professorship in gas engineering and fuel at the Leeds University. The committee having the matter in hand announces that contributions to the fund should be sent to the secretary of the Institution of Gas Engineers, 39 Victoria Street, Westminster. A sum of at least 10,000*l.* is required for the object in view.

THE University of Liverpool has received an offer from Mr. Alexander Elder, of Southport, formerly of Elder, Dempster, and Co., Liverpool, to contribute 12,500*l.* for the establishment of a chair of naval architecture in the University. The proposal will be considered by the University council at its next meeting. The foundation of such a professorship would of necessity mean a great expenditure in fitting and equipping lecture-rooms and laboratories, and in maintaining the work of the new department. It is hoped that other gifts will be forthcoming to make it possible for the council to accept Mr. Elder's generous offer.

THE Rev. Lord William Cecil is proceeding to China at the request of an influential committee of graduates of Oxford and Cambridge to try to found a Christian and educational university there. At present much educational work is being done by the American missions, but very little by the English. It is thought that one union university will be more efficient and more economical than many smaller establishments working without method. It is hoped to avoid the difficulties of divergent religious teaching by founding a university on the lines of Oxford and Cambridge. While each college of the university will be under the control of some mission body, the university itself, like Oxford and Cambridge, will not be attached to any one denomination. The university will concern itself chiefly with the teaching of arts, science, and engineering. The university is not intended to be a permanent foreign settlement in China. With the growing body of Chinese Christians, it is expected that the chairs may be filled soon with those who have been students in the university.

WE have received a printed copy of a lecture delivered by M. Jules Gautier, director of secondary education in France, last October, under the auspices of the British Education Section of the Franco-British Exhibition, on the progress of secondary education in France since the time of Napoleon I. It is interesting to notice in the lecture that science was introduced in the curriculum of French secondary schools so far back as 1821, while in 1829 the idea was prevalent that Latin and science formed a suitable training for young men wishing to enter the Army or the Diplomatic Service. In 1852 the system was introduced of dividing pupils, after the preliminary stages, into two groups, those who wanted a literary or classical education and those who wanted a scientific education, but this system was short-lived. It was not until 1902 that the present system was inaugurated. To-day French secondary education is divided into two cycles; the first is concerned with the years from ten to fourteen, and the second with the remaining school years. In the first cycle science is

taught in varying amounts, and in the second cycle science is included in each of the four different courses open to pupils.

THE University of London has arranged several series of advanced lectures in science for the spring term. The lectures are addressed to advanced students of the University and to others interested in the subject dealt with. Admission is free, without ticket. A course of eight lectures on "Physical Chemistry, and its Bearing on Biology," will be given by Dr. J. C. Philip at the Imperial College of Science and Technology, S.W., on Mondays at 5 p.m., from January 25 to March 15. Four lectures on "The Use of Vertebrate Fossils in Stratigraphical Geology" will be given by Dr. A. Smith Woodward, F.R.S., at the Imperial College of Science and Technology on Mondays at 5 p.m., beginning on February 1. The reader in meteorology, Dr. W. N. Shaw, F.R.S., will give ten lectures on "The Climates of the British Possessions" at the London School of Economics on Fridays at 5 p.m., beginning on January 22. Three lectures on "The Anatomy and Zoological Relationships of the Anthropoid Apes," by Prof. Arthur Keith, will be given at the Royal College of Surgeons, Lincoln's Inn Fields, on Friday, January 15, Thursday, January 21, and Friday, January 29, at 5 p.m. Three Chadwick lectures on "The Medical Aspects of Recent Advances in Hygiene as connected with Sewering" will be delivered at the University by Dr. Louis C. Parkes on Tuesdays at 4 p.m., beginning on February 2.

THE Governor of Bombay recently addressed a long letter to the registrar of the Bombay University propounding a new scheme of science teaching. According to the *Pioneer Mail*, the letter concludes:—The Governor in Council is well aware of the difficulties which must attend so drastic a revision of the University curriculum as in his opinion is urgently required, and he fully recognises that the essential reforms must be gradually carried out. He is confident, however, that the Senate will approach with a single eye to the efficiency of higher education in the Presidency, the proposals which in reply to the request contained in their letter of August 8 last he now lays before them, and will share with him the earnest desire that the University of Bombay should be brought into line with the great developments in educational methods which have assumed practical form in recent years, and they will not fail to realise the bearing of these developments upon national advancement. The recent splendid benefactions towards the improvement of science teaching have removed some of the obstacles to the movement in the required direction. The most pressing questions, therefore, to which the Senate will doubtless give the earliest consideration are those relating to the proposed changes in the science courses. So soon as an agreement has been reached on the principles involved, it will be possible to take the initial steps for starting an institute in which the teaching of science can eventually be concentrated and rendered worthy of the Presidency of Bombay.

INTERESTING statistics concerning the registration of students in American universities last October are given by Prof. Rudolf Tombo, jun., in *Science* of December 25, 1908. Comparing the figures for 1908 with those of the previous year, Prof. Tombo shows that, in spite of the prevailing economic depression, only two American universities, Harvard and Stanford, show a slight loss in enrolment, whereas two years ago five universities suffered a decrease. Taking the total attendance into consideration, *i.e.* including the summer session, the greatest gains of students have been made by the universities of Chicago, Columbia, Wisconsin, Indiana, Pennsylvania, Cornell, California, and Minnesota, each one of these having gained more than four hundred students; omitting the summer session attendance, the largest increases have been registered by the universities of Columbia, Minnesota, Cornell, Northwestern, Wisconsin, Pennsylvania, and Ohio, in the order given, the growth in each case being one of more than three hundred students. The only institutions that have registered a decrease in the number of students studying science are Harvard, Kansas, Nebraska, and Virginia, and of these the first mentioned is the only one that shows a loss as compared with 1902, this being due to the fact that the baccalaureate degree is now required for admission to the Harvard engineering schools. The gain in the number of science students since 1902 is in several instances remarkable, *e.g.* from 597 to 1352 at Michigan University. The largest number of students of science is still found at Cornell University, Michigan and Illinois being the only others that attract more than one thousand students to their scientific schools; these are followed by Yale, Ohio State, Wisconsin, California, Pennsylvania, Minnesota, Columbia, Missouri, Nebraska, and Princeton, each of these universities having more than five hundred students in attendance at their scientific schools.

THE report of the British Education Section of the Franco-British Exhibition, 1908, has now been printed and circulated. Although exhibits of our educational system and its results have formed part of the several international exhibitions which have been held in various countries during the past twenty-five years, no adequate demonstration of the wide scope of the aims of British educational activity, the variety of its methods, and the magnitude of its results had ever been brought before the public within the United Kingdom before that in connection with the exhibition of last year. The exhibits were contributed by some 160 organisations in all parts of the kingdom, and were drawn from more than 1550 schools, colleges, and other educational institutions. The important place in our educational system now filled by technical instruction claimed for it special treatment. This was secured by a large collective exhibition, representative of the various types of work done by the respective technical schools and institutes of the country, the organisation of which was undertaken by the council of the Association of Technical Institutions, while the City and Guilds of London Institute showed, by an exhibit of the statistics of its department of technology, the uninterrupted progress that has been made in the organisation of practical instruction in the different branches of industrial work. Large parties of teachers from Manchester, Bolton, Nottingham, Newcastle-on-Tyne, Darlington, Wakefield, Stockton, Middlesbrough, Rochdale, Grimsby, Barry, Wimborne, and other places visited and inspected the section during August and September. Moreover, special commissioners, appointed by their respective Governments to study the methods and results of British education, came from China, Japan, Spain, Algiers, Hungary, Cuba, New South Wales, New Zealand, and other countries, while amongst the most frequent visitors in the autumn months were many teachers from the United States and Canada.

THE annual meeting of the Geographical Association was held at the London School of Economics on January 6. The morning was devoted to technical papers on methods of geographical instruction. The excellent work which the association is doing in the direction of applying scientific methods to the teaching of geography is indicative of the new spirit which is inspiring schoolmasters and schoolmistresses. Until recently it was customary to rely wholly upon the teacher's explanations, and the pupils were expected to listen and remember merely; nowadays, in the best schools, the pupil is made to take an active part in the work and to deduce geographical principles from practical exercises based on maps, the graphing of curves, the reading of measuring instruments, and many other branches of the subject. The character of the morning papers read to a large and interested audience of teachers reflected this gratifying change. The afternoon session also was largely attended. It was announced that the membership had increased by 250 during last year, and is now 793. In his presidential address Mr. Douglas Freshfield said he had brought one satisfactory item of news from the Royal Geographical Society, namely, that the council of the Royal Geographical Society and the University of Oxford have agreed to maintain their respective contributions to the Oxford School of Geography for another period of five years. The school grows in size and reputation, and it only remains for some pious benefactor, some city company, or colonial millionaire to build himself a lasting monument by providing the school with a suitable

home worthy of the first school of geography in the British Empire. At Cambridge also the geographical spirit is active, and new developments may be expected. Extension meetings in the summer spread university teaching far and wide, and everywhere there are signs that teachers who take an interest in their subject are multiplying, and that the conception of geography as a study for mental discipline is spreading. No one in touch with education speaks apologetically nowadays of geography. It has won its place, in comparison with physical science and history, as a science full of problems as well as facts, a mental exercise of no mean order. It is not only to the classical student, but to the man of science, the economist, and the statesman, and Mr. Freshfield added, to the elector, that a just knowledge of geographical conditions may prove serviceable. The abysmal ignorance of the British Empire in large classes of our countrymen who are allowed a share in controlling its destinies is not the least of our national dangers. Dr. H. R. Mill delivered a lecture on the rainfall of the British Isles, and Mr. G. W. Palmer, of Clifton College, gave a lantern exhibition of a set of views of the Dora Baltea.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 12, 1908.—"The Natural Mechanism for evoking the Chemical Secretion of the Stomach." By J. S. **Edkins** and M. **Tweedy.** Communicated by Prof. E. H. Starling, F.R.S.

By a special method, elsewhere described, the authors were able to restrict the introduction of food material to definite portions of the stomach and intestine. It was therefore possible to test how these different regions behaved as channels for absorption, and what the comparative value of different food substances was in respect of the evoking of the chemical mechanism of secretion of gastric juice. The fundus of the stomach was found to be non-functional in absorption, the pyloric end of considerable value, and absorption in the duodenum also stimulated the fundus to secrete. It was observed that acid alone is but a slight stimulus; dextrin has a marked effect similar to that shown by dextrose and maltose. Commercial peptone and the meat extract devised by Herzen, of Geneva, were found most potent of the substances experimented on.

No evidence was found of any negative hormone passing into the circulation tending to inhibit gastric secretion. The pyloric end of the stomach and the duodenum are to be regarded as the normal channels of such absorption as liberates the gastric hormone. The fundus is definitely excluded.

Royal Microscopical Society, December 16, 1908.—Mr. Conrad Beck, vice-president, in the chair.—(1) A workshop microscope for the examination of opaque objects; (2) a simple method of illuminating opaque objects: J. E. **Stead.**—Mounting rotifers and Protista in Canada balsam: Rev. Eustace **Tozer.**

EDINBURGH.

Royal Society, December 21, 1908.—Prof. Crum Brown in the chair.—A photographic apparatus for automatically recording the readings of the scale and vernier of any instrument: Dr. J. R. **Milne.** The apparatus was a specialised form of camera. When the observer wished to make a reading he pressed a small lever, which set in motion the automatic mechanism. The shutter was first opened and closed, and then the plate was moved on a step so as to bring a fresh part of its surface into position. A 5-inch by 4-inch plate could in this way be covered with seventy small photographs of the scale and vernier, and these could be read off at leisure afterwards. Not only was the work of the observer much lightened, but his eyes were spared much fatigue, while a permanent record was obtained in which there could be no error due to bias or a mistake in reading. The author had used this camera for some time in connection with a polarimeter, and had found it of great advantage in recording the readings of the Nicol.—The friction at the extremities of a short bar subjected to a crushing load, and its influence upon the apparent compressive strength of the material: G. H. **Gulliver.** As regards the effect of the friction of the crushing plates upon the yield point of short compression specimens, it was found that with plates harder than the material under test the end friction caused an increase in the apparent yield-point stress. This increase was calculated approximately as 20 per cent. for wrought iron and mild steel, 20 per cent. for cast iron, and from 50 per cent. to 200 per cent. for stones, bricks, and concrete. These figures, except the first, might apply almost equally well to the crushing strength, but they required experimental verification. The corresponding inclinations of the surfaces of sliding were $-37°$ for wrought iron and steel, 36° for cast iron, and 27° to 18° for stone, &c. The first value was seldom obtained, but the others agreed fairly well with average experimental results. With the crushing plates of softer material than that under test, the lateral flow of the former diminished the apparent strength of the specimen. For stones crushed between lead plates the calculation indicated a strength from 0·35 to 0·15 of that obtained with iron or steel crushing plates. Experiment gave from 0·65 to 0·45 as the value of the ratio, but the specimens did not rupture by shearing in the manner contemplated in the theoretic discussion. The total crushing load of a short specimen of cast iron was increased by diminishing the length of the piece, but the crushing stress per unit area was simultaneously decreased.

January 4.—Dr. R. H. Traquair, F.R.S., in the chair.—The fossil Osmundaceæ, part iii.: Dr. R. **Kidston** and D. T. **Gwynne-Vaughan.** The paper contained a detailed description of three osmundacean fossils from the Permian of Russia. In the most important, *Thamnopteris Schlechtrudalii*, the protostele of the stem has a solid central mass of xylem. The most central tracheæ are short, vesicular and reticulate, and are regarded as being transitional to a parenchymatous pith. On leaving the stele the xylem of the leaf trace is oval in transverse section with a mesarch protoxylem, and on its way through the cortex it gradually changes into the adiaxially curved C-shaped trace of the Osmundaceæ. These changes are held to represent the phylogeny of the adiaxially curved C-shaped trace in general. The stem stele of the Zygopterideæ is held to be phylogenetically connected with that of the Osmundaceæ.—Supplementary report on the hydroids of the Scottish National Antarctic Expedition: James **Ritchie.** Twenty-five species, mostly from the sub-Antarctic and temperate seas, have been added to the list already recorded, bringing the total number of the species and varieties in the *Scotia* hydroid collection up to sixty-one. Several new forms were described, and the known ranges of distribution of many species have been considerably extended.

PARIS.

Academy of Sciences, January 4.—M. Bouchard in the chair.—Certain systems of linear differential equations: Gaston **Darboux.**—The possible danger of turning over in the steering of aëroplanes: L. F. **Bertin.** From an examination of the aëroplanes in current use the author comes to the conclusion that there is a real danger of the whole machine turning over, either by the action of the wind or by the lateral pressure caused by steering out of the straight line. It is pointed out that further experimental data are needed.—Prof. Zirkel was elected a correspondant in the section of mineralogy in place of the late Carl Klein.—The multiform integrals of algebraical differential equations of the first order: Pierre **Boutroux.**—Directed waves in wireless telegraphy: Albert **Turpain.** A reclamation of priority as regards the work of M. Blondel.—Polar magnetic storms and the aurora borealis: Kr. **Birkeland.** Reproductions of eleven photographs are given, in which the phenomena of the aurora are experimentally imitated.—Modifications of the difference of contact potential of two aqueous solutions of electrolytes under the action of a continuous current: M. **Chanoz.** The passage of a continuous current through the contact surface of two aqueous solutions of electrolytes, MR, M'R', is capable of modifying the difference of potential between the two liquids. This variation of potential produced depends, both for intensity and sign, not only on the nature of the solutions, but also on the direction of the passage

of the current through the contact considered.—The influence of the quality of the lighting on the photographic reproduction of colour: J. **Thovert.**—The freezing of mixtures of water and soluble fatty acids: A. **Faucon.** Solutions of formic, acetic, and propionic acids were used. The freezing points of the eutectic mixtures with these three acids were -48°, -27°, and $-29^{\circ}\cdot4$ respectively, and no formation of any hydrate could be proved.—The density of methane and the atomic weight of carbon: George **Baume** and F. Louis **Perrot.** The gas was prepared by the action of water on methyl-magnesium iodide, and after washing purified by fractional distillation under reduced pressure. Air being appreciably soluble in liquid methane, special precautions were necessary to remove this impurity. The mean weight of the normal litre of methane was found to be 0·7168 gram. According to the method of reduction employed, the atomic weight of carbon from this density is deduced as 12·004 (Leduc), 12·005 (D. Berthelot), and 12·003 (P. A. Guye).—Concerning the atomic weight of silver: A. **Leduc.** A reply to some criticisms of M. Dubreuil.—The silicides of hydrogen: P. **Lebeau.** A large quantity of the gas produced by the action of hydrochloric acid on magnesium silicide was cooled with liquid air, and the compounds of silicon with hydrogen submitted to fractional distillation. Besides pure SiH_4, not inflammable in air, a gas the density of which (2·18) corresponded with Si_2H_6 was obtained. A third compound, isolated in small quantity, and characterised by its extreme inflammability in contact with air, is probably silico-ethylene, Si_2H_4. It is this substance which renders the impure silicon hydride spontaneously inflammable.—A case of isodimorphism: H. **Marais.** The forms of ethylamine chlorhydrate and bromhydrate stable at the ordinary temperature are perfectly isomorphous. The forms realisable at higher temperatures are isodimorphous, the stable form of one of the bodies being isomorphous with the unstable form of the other.—The hypotypical regeneration of the chelipeds in *Atya serrata*: Edmond **Bordage.**—Leprosy and demodex: A. **Borrel.**—The parthenogenetic segmentation of the egg in birds: A. **Lécaillon.**—The gastric digestion of casein: Louis **Gaucher.** Coagulation of the milk does not necessarily occur in the stomach, and is not peptonised in that organ.—The effect of bases on the action of certain ferments: C. **Gerber.**—A gravimetric method of constant sensibility for the measurement of high altitudes: Alphonse **Berget.** The apparent variation of the weight of a body, passing from one altitude to another, is proportional to the difference of level of the two stations. This variation is of the order of 1/10,000 for the height of the Eiffel Tower.—Rain and springs in Limousin in 1908: P. **Garrigou-Lagrange.**—The earthquake of December 28, 1908: Alfred **Angot.** A reproduction of the curve registered by the Milne seismograph at the Parc Saint-Maur Observatory is given.—The earthquake of December 28, 1908: R. **Cirera.** An account of observations made at Ebro.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 14.

ROYAL SOCIETY, at 4.30.—The Yielding of the Earth to Disturbing Forces: Prof. A. E. H. Love, F.R.S.—The Relation of the Earth's Free Precessional Nutation to its Resistance against Tidal Deformation: Prof. J. Larmor, Sec.R.S.—Notes on Observations of Sun and Stars in some British Stone Circles. Fourth Note. The Boballek Circles, St. Just, Cornwall: Sir Norman Lockyer, K.C.B., F.R.S.—On the Depression of the Filament of Maximum Velocity in a Stream flowing through an Open Channel: A. H. Gibson.—On the Passage of Röntgen Rays through Gases and Vapours: J. A. Crowther.—On the Velocity of the Cathode Rays ejected by Substances exposed to the γ-Rays of Radium: R. D. Kleeman.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The G. B. System from a Tramway Manager's Point of View: Stanley Clegg.

MATHEMATICAL SOCIETY, at 5.30.—The Canonical Form of a Linear Substitution: H. Hilton.—On the Solution of the Quintic: J. Hammond.—On Octavic and Sexdecimic Residuacity: Lieut.-Col. A. Cunningham.—On Change of the Variable in a Lebesgue Integral: Dr. E. W. Hobson.—On Abel's Extension of Taylor's Series: Rev. F. H. Jackson.—Note on the Evaluation of a Certain Integral containing Bessel's Functions: Prof. H. M. Macdonald.

FRIDAY, JANUARY 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Filtration and Purification of Water for Public Supply: John Don.

MONDAY, JANUARY 18.

ROYAL SOCIETY OF ARTS, at 8.—The Public Supply of Electric Power in the United Kingdom: G. L. Addenbrooke.

VICTORIA INSTITUTE, at 4.30.—Science and the Unseen: Dr. A. T. Schofield.

TUESDAY, JANUARY 19.

ROYAL INSTITUTION, at 3.—Albinism in Man: Prof. Karl Pearson, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: High Speed on Railway-curves: J. W. Spiller.—A Practical Method for the Improvement of Existing Railway-curves: W. H. Shortt.

WEDNESDAY, JANUARY 20.

ENTOMOLOGICAL SOCIETY, at 8.—Annual General Meeting.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Presidential Address, by Lord Avebury: On Seeds, with Special Reference to British Plants.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Annual General Meeting.—Address on Some Aims and Efforts of the Society: Dr. Hugh Robert Mill.

THURSDAY, JANUARY 21.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Syntonic Wireless Telegraphy, with Specimens of Large-scale Measurements: Sir O. Lodge, F.R.S., and Dr. Alex. Muirhead, F.R.S.—The Leakage of Helium from Radio-active Minerals: Hon. R. J. Strutt, F.R.S.—The Mobilities of the Ions produced by Röntgen Rays in Gases and Vapours: E. M. Wellisch.—On the Electricity of Rain and its Origin in Thunderstorms: George C. Simpson.—The Photo-electric Fatigue of Zinc, II.: H. Stanley Allen.

LINNEAN SOCIETY, at 8.—The Genus Nototriche, Turcz: Arthur W. Hill.—The Longitudinal Symmetry of Centrospermeæ: Dr. Percy Groom.

ROYAL INSTITUTION, at 3.—Mysteries of Metals: Prof. J. O. Arnold.

FRIDAY, JANUARY 22.

ROYAL INSTITUTION, at 9.—The World of Life: as Visualised and Interpreted by Darwinism: Alfred Russel Wallace, O.M., F.R.S.

PHYSICAL SOCIETY, at 5.

CONTENTS.

THURSDAY, JANUARY 21, 1909.

PLANT PHYSIOLOGY AND ECOLOGY.

Plant Physiology and Ecology. By Prof. F. E. Clements. Pp. xv+315; 125 illustrations. (London: A. Constable and Co., Ltd., 1907.) Price 10*s*. 6*d*. net.

THE task of summarising the principles of ecology and other branches of botany concerned with the relation of plant to environment is one with which teachers are confronted at the present time. Prof. Clements in this book outlines a course which he has carried out in a session with second-year students. His views on vegetation as an "organism" are already known from "Research Methods in Ecology" and other publications. The present book, briefly stated, is an attempt to graft on to "Research Methods" the physiology of Sachs and Pfeffer and the ecology of Warming and Kerner. The tree shows signs of one day being a symmetrical organism, but at present the traces of the grafting are somewhat conspicuous. Prof. Clements has all along taken up his standpoint without much consideration for the traditions of European schools; yet anything he writes is worth careful consideration. "Research Methods" was distinguished by such a marked disregard for principles admitted in Europe that it provoked much criticism; one, therefore, turns to the new book curious to see what the last three years have brought about.

The opening chapter is axiomatic, therefore important. The author's conception of physiology is given in his own words. "A plant is an organism capable of nourishing itself under the control of external conditions, and of modifying its form and structure in accordance with this fact." "The proper task of physiology is the study of the external factors of the environment or habitat in which the plant lives, and of the activities and structures which these factors call forth." "The former are causes, the latter effects." "The sequence of study is consequently factor, function, and form." "Physiology was originally understood to be an inquiry into the origin and nature of plants." "This is the view that pervades the following pages, and in accordance with this the subject-matter of ecology is merged with that of physiology." A stimulus is defined as "any factor of the habitat that produces a change in the functions of a plant." The real test of a stimulus is "furnished by the plant, since the presence of a stimulus can only be ascertained by the response made by the plant." Stimuli are grouped "with respect to the force concerned." "The factors of a habitat are water, soluble salts, humidity, light, temperature, wind, soil, pressure, physiography, gravity, polarity, and biotic factors." "Certain of these, namely, soil, physiography, pressure, and biotic factors, can act upon plants only through the action of other factors, as a rule." This grouping together of all the factors of the habitat as stimuli, in "Research Methods," evoked the criticism of physiologists accustomed to distinguish between work which is the direct outcome of energy flowing in from without (transpiration and photosynthesis), and work done as the equivalent of potential energy, the conversion of which is set going by inflowing energy ("New Phytologist," iv., p. 234). Commenting on this distinction between tonic and stimulatory action, Prof. Clements says:—"a careful analysis of these two processes shows that at the bottom they are essentially the same," and differ only in degree. He also adheres to his earlier views on the nature of response. Adjustment is "functional response" where "reactions to stimuli are functional only." Adaptation is "structural response" where a structural change also occurs. "Adjustment may be expressed in the movement of parts or organs . . . or in growth or modification of structure." "Adaptation comprises all structural changes resulting from adjustment."

These are fundamental principles of this book. Five chapters (pp. 7–143) are concerned with adjustment to water, light, temperature, and gravity; two (pp. 144–184) with adaptation to water and light. The chapter (ii.) on "the water of the habitat" is already familiar to readers of "Research Methods." The difficulties of a beginner in field-work are not quite fully realised, but with the aid of this chapter and the experiments suggested he should be able to grasp the objects of this line of investigation. The system employed in framing the chapters on adjustment is to give a general—often a very general—outline of the structure of the organs concerned and to add experiments on function. This part of the work lays itself open to frequent criticism, and most instructors, while appreciating the suggestions, will improve along their own lines. Adjustment to water is subdivided under topics; "absorption" includes structure and function of the root and the principles of imbibition, osmosis, diffusion, and turgidity; "transport" includes brief descriptions of stem structure and the upward movement of water; "transpiration" deals with leaf structure and function. One must admit that it is no easy task to give a condensed account of these processes, but a clear conception of them is essential, even to the ecologist, and their treatment here does not satisfy. Either the student has become familiar with elementary anatomy and physiological experiments during an earlier period of his course, or he ought to know more than is given in these pages. Many phrases suggest a first primer; thus, "the fibrovascular system is usually in the form of an interrupted circle of bundles strung like beads upon the ring of cambium." So also do some experiments; thus, osmosis is demonstrated by a thistle funnel and parchment (no other experiment), and turgidity with a piece of "dialyser tubing." The ecologist may be sadly in need of the more intimate and exact methods of the physiologist, as Prof. Clements says, but this deficiency is not removed by acquaintance with a few elementary experiments, and the ecologist should be induced to follow the latest the laboratory physiologist is doing. One cannot help thinking that the author has not taken this part of his work seriously, but has thrown out as suggestions what first came to mind; even in the proof-

reading perfection is not aimed at; in one case (p. 68) several errors occur in a few lines.

The chapter on adjustment to light deals with light stimuli, the measurement of light, and the process of photosynthesis. Under "Adjustment to Temperature" the relation of plants to temperature is included along with digestion, respiration, germination, nutrition of hysterophytes, growth, reproduction, and propagation. The connection of all these with temperature is not very obvious, as they are the outcome of many factors. In an ecological text-book one might well expect a more recent treatment of propagation, a subject of prime importance, and one to which Danish and Swiss workers have given much attention. The chapters on adaptation to water and to light include all structural changes, and they proceed on conventional lines: decrease of water-loss through leaf position, rolling of the leaf, changes of epidermal cells, stomata, &c.; types produced by adaptation to water, xerophytes, &c.; the relation of organs to light, types of leaves as determined by light, and other topics. "The Origin of New Forms" (chapter ix.) includes a short history of evolution, and sketches rapidly origin by adaptation, variation, and other processes.

The latter part of the book (chapters x.–xv.) shows Prof. Clements at his best. His views as given in "Research Methods" have already had great influence; these form the basis of the chapters in the present work, but the new arrangement is a great improvement on the old. The study of vegetation by quadrats and transects is now a recognised method of the ecologist, and the chapter on it forms a good introduction for the advanced student. The plant formation (chapter xi.) is defined as "an area of vegetation, such as a meadow, a forest, a prairie, a bog, a cliff covered with lichens, or a pond of water-lilies." The cautions given under "recognition of formations" are timely, because "the unit itself shows parts which may be mistaken for formations"—a very common error. The formation depends on habitat, and is a product of it, but the author wisely points out the existence of a historical factor "due to the accidents of migration and competition, or to the fact that the plant itself has a certain ancestral or historical quality that enables it to persist." No student of ecology can omit to read carefully the description of the formation, or what one naturally calls the "Clements formation"; it matters little whether it is synonymous with the conceptions of other authors, but it is an introduction to the varying phases of vegetation which in its definiteness and detail has few rivals. The chapters discussing aggregation and migration (xii.), competition and ecesis, or the adjustment of a plant to a new habitat (xiii.), invasion and succession (xiv.), and alternation and zonation (xv.) are all important; they deal with features one constantly meets in the field, and these chapters will assist much in giving that mental perspective so greatly needed in Britain, where the units of vegetation are limited in extent and liable to disturbance.

The irritating nomenclature of "Research Methods" does not appear in this book; such terms as are retained are few, and so useful that they have already been adopted. The illustrations, where they refer to ecology, are helpful and are well reproduced. The provision of an index is an improvement on the author's former book, but we think the omission of references to literature is not justifiable in this period of ecology and in a book which is obviously only feeling its way. The publication of this book will have a marked influence on teaching, and it is well that one backed by so much experience should lead the way. The enthusiasm of the author can be traced through every page; ecology is always in his mind, and he weaves it into botanical teaching from the commencement. The course leads in the right direction, although slight differences of opinion on detail may be inevitable. W. G. S.

MARINE METABOLISM.

Conditions of Life in the Sea. A Short Account of Quantitative Marine Biological Research. By J. Johnstone. Pp. xiv+332. (Cambridge: University Press, 1908.) Price 9s. net.

SINCE Hensen published, in 1887, the first account of his methods for the quantitative estimation of the plankton, an ever-increasing number of workers has entered the field of marine biological research. To quote from the author in the preface:—"It is characteristic of a really great idea in science that it should stimulate further discovery by the suggestion of new lines of research and new methods of investigation." Already many results of the greatest interest have been obtained, and the lines on which modern research is being carried out are rich in promise. The absence of any adequate summary of these researches has been a serious gap in scientific literature, for on account of the diversity and inaccessibility of a great number of the memoirs, this subject still remains a *terra incognita* to the great majority of readers. To meet this demand in a satisfactory manner the range of the subjects that would have to be entered into is very considerable; and Mr. Johnstone is to be congratulated on the masterful manner in which he has carried out this task in writing "Conditions of Life in the Sea." A clear and concise account of all the more important work is given in language devoid of unnecessary technicalities, and in dealing with the more speculative problems the author states *pro* and *con.* with an impartiality which is quite refreshing.

Part i. is an introduction to the problems discussed later on in the work, and is primarily intended for the benefit of those who have no special knowledge of oceanography. A short account is given of the gear and methods of the marine biologist. Facts relating to the geology and to the hydrographical and physical conditions of the north-western ocean are summarised. The reader is made familiar with the commoner and more widely distributed marine fauna and flora, special reference being made to the plankton. Finally, the economic and biological importance of the fishing industries is briefly outlined.

Part ii. deals with the methods and results of quantitative biological research. The author discusses fully the classical experiments of Hensen and Lohmann on the quantitative estimation of the plankton, giving the defects and limitations of these methods without bias. The last two chapters in this section are headed "A Census of the Sea" and "The Productivity of the Sea"; in them an attempt is made to view questions of economic value from a quantitative biological standpoint. That the estimation of the number of marketable marine fishes on a given fishing area, or calculations as to its yield per acre per annum, must as yet be purely speculative is fully appreciated. This, however, does not detract from the great value of these deductions, the interest in figures such as these lying more in the possibilities they suggest than in their mathematical correctness. The system of "trial and error" enters so largely into scientific investigation that perfection cannot be hoped to be attained without the aid of some such provisional results.

Part iii., under the title "Metabolism in the Sea," is, perhaps, the main feature of the book. The researches of Pütter on the nutrition of marine organisms, and those of Brandt on the "Law of the Minimum," are treated at length. A chapter is devoted to marine bacteria, and emphasis is laid on the possibility that nitrogen is the determining factor in the sea, and the denitrifying bacteria the cause of the observed scarcity of nitrates and nitrites in tropical and subtropical waters. The extraordinary abundance of planktonic life in the Arctic seas has given rise to much discussion, but in our present state of knowledge this phenomenon can be best explained by the hypothesis that, owing to the inhibition of bacterial activity at low temperatures, there is no diminution from this cause in the supply of the nitrogenous foodstuffs that can be utilised by the marine protophyta. The constituents of sea-water such as nitrates, phosphates, silica, &c., are present in such minute traces that quantitative determination is extremely difficult. The author might have laid greater stress on this point, since no really satisfactory methods of analysis have yet been perfected.

References to literature, a most important point in a work of this kind, are given freely throughout the text, a bibliography of the more fundamental memoirs being also included as an appendix. Authors and subjects are indexed separately, so that references can be most easily found.

Besides a few obvious misprints we note the following:—P. 67, line 2, oviparous for viviparous in reference to Acanthias, the spur-dog; p. 96 (in the diagram), Aurelia, Rhizosolenia, should read Aurelia, Rhizostoma; and p. 103, line 1, agriculture for aquiculture.

The illustrations are mostly quite diagrammatic, and as such serve their purpose, but in some cases (pp. 68, 79) clearness is sacrificed by representing plankton animals lying across one another. The printing, binding, &c., are uniform with the well-known "Cambridge Biological Series," to which this work is a welcome addition.

E. W. Nelson.

ANATOMY OF THE HORSE.

The Surgical Anatomy of the Horse. Part iii. By J. T. Share-Jones. Pp. x+220. (London: Williams and Norgate, 1908.) Price 15*s.* net.

THE third of the four volumes which are to form a "Surgical Anatomy of the Horse" deals with the hind limb, and will doubtless fulfil the author's hope that it may be "at least as acceptable as the preceding volume both to students and practitioners in the study and practice of the important branch of veterinary work to which it relates." The present volume has all the merits of its predecessors. Of its value as a means by which the practitioner may refresh his memory of the anatomy of the regions with which he is concerned surgically there can be little question. In some places the anatomical descriptions are both long and detailed, and contain all the information which is in any way important. At the same time, the present part of the work is not without some of the defects exhibited in those sections of the work which have already been noticed in these columns.

One matter which the author would be well advised to ponder, in view of the possible demand for a subsequent edition, is that of having all the figures drawn from either the right or the left limb. It does not make for ease of comprehension to find that neighbouring plates illustrate the one the right the other the left limb. Comparison would be a much simpler matter if all the figures represented the same side of the body. It is bad enough when different plates do not correspond, but it is exasperating when the same plate contains figures some of the right and some of the left limb. In Plate xviii., Fig. A shows the superficial markings of the *left* hock, Fig. B illustrates the arrangement of the ligaments from the same aspect of the *right* hock, and Fig. C depicts the disposition of the bones on the medial side of the *left* hock. It may be remarked in passing that Figs. B and C of Plate xx. are not of the *left* hock. Plates xxiv. and xxv. both illustrate the seat of anterior tibial neurectomy, but one figure is drawn from the left limb, the other from the right.

While recognising the enormous importance of the tarsus as a surgical region, we are not prepared to admit that it is necessary to have seven figures to illustrate the position of the various bones, nor are we prepared to allow that the grooves and ridges on the medial side of the tarsus are of such surpassing significance as to merit so much attention. Their importance from the clinical aspect is open to question, and, from the anatomical side, it is clearly recognised that the degree of their variation is great.

Mr. Share-Jones again makes use of a nomenclature in the defence of which there is little to be said. So long, however, as his readers understand what is meant, exception can be taken to the terms employed on academic grounds only. At the same time, it seems a pity that adjectives like "external lateral" and "internal lateral" should not be omitted, if only on the grounds of the desirability of brevity.

To apply the term "sciatic" to the internal

popliteal nerve (n. tibialis) until it arrives on a level with the heads of the gastrocnemius muscle is not justified by common usage among anatomists. An error, in the commission of which the author is not alone, is in the spelling "tendo-Achilles."

The judicious use of quotations is to be commended, but Mr. Share-Jones is not well advised in the insertion of too long quotations. We feel that the work would have lost nothing in clearness, and would have gained something in terseness, had the quotations been condensed into a few lines or omitted altogether. There seems little point, for example, in the views of Percival on "ossific diathesis," quoted by W. Williams and re-quoted by our author.

The fact that the author treats his subject so largely from the surgical side leads one to examine the surgical paragraphs with even more care than those which are purely anatomical. Surgery certainly is an art, and not one of the exact sciences, and, therefore, affords great scope for difference of opinion. Mr. Share-Jones, consequently, is entitled to express whatever views he may happen to hold, but he need not be surprised if his readers occasionally disagree with him. It may be doubted, for instance, if it is possible in cases of so-called deferred fracture of the tibia to detect the line of fissure by palpation. It is a matter of opinion whether crepitus can be elicited by manipulation in fractures through the acetabulum. There are those who would say that crepitation can be best produced by movements by the horse himself.

The professional reader, moreover, may inquire why epiphyseal fractures of the femur of young animals are omitted, or, in fracture of the femur, how the bony fragments are to be retained in position, or what may be the value of periosteotomy in "spavin," and how it is done. On many other points, it is safe to say, the practitioner will feel irritated at paucity of information, or will dissent, sometimes strongly, from the views expressed.

From what has been said it is clear that the present part of the "Surgical Anatomy of the Horse" is not without blemish to detract from its numerous merits.

GLASS DECORATION.

Decorative Glass Processes. By A. L. Duthie. Pp. xii+267. (London: A Constable and Co., Ltd., 1908.) Price 6*s.* net.

THE book before us contains a minutely detailed account of a number of processes employed for the purpose of producing architectural decorative work in glass. Beginning with an account of the various kinds of glass available for such work, and indulging in a retrospect of glass-working that takes the reader back to ancient Egypt, Mr. Duthie describes the production of leaded lights, the technique of glass painting and staining, and the various processes which depend upon the partial obscuring of the glass by means of fluorides or by the action of the sand-blast. Finally gilding, silvering, mosaic, and a number of special processes are described.

Mr. Duthie's account of the varieties of glass available for decorative work is interesting especially as regards the production of "antique" glass with its intentional "imperfections," such as bubbles, striæ and partial devitrifications. On the other hand, the statement that polished plate glass is made by polishing "rough cast plate" serves to indicate that the author is not intimately acquainted with this side of glass manufacture.

In his detailed account of the technique of the various crafts concerned in the production of decorative glass, Mr. Duthie is, perhaps, somewhat uninteresting to the general reader—the descriptions are too minutely detailed and given in rule-of-thumb manner—while for the practical worker the book may serve as a useful reference for recipes not in constant use, but would scarcely be adequate for the needs of a learner. A larger amount of space devoted to the principles of the technique, even at the expense of some of the detailed directions, would have been preferable. Ideas and principles are, however, only introduced in reference to the questions of art involved in the designs for various types of work. This is, perhaps, scarcely the place to discuss these questions, but the fine illustrations with which the author's views are exemplified deserve special comment. Some of these, such as Fig. 15 (leaded panel), Fig. 31 (triple embossing), and Fig. 38 (electro-copper glazing), are particularly fine; the latter is also of special interest technically, as it illustrates a very successful application of an electro-deposition process to glass work. In this work the lead flanges or "calms" are replaced by thin strips of copper laid between the different pieces of coloured glass; upon the projecting edges of these bands ledges of copper are electro-deposited, flanges being thus formed which grip the glass and consolidate the whole panel.

Scientific readers will be particularly interested in the manner in which the action of hydrofluoric acid and of soluble fluorides is utilised for the production of glass surfaces of various degrees of opacity, ranging from the "dead white" of the pure fluoride to the practically clear glass left by the pure acid. As Mr. Duthie remarks, however, it is certainly surprising to find this etching process known by the trade term "embossing," a term which rather suggests the products of the pressed-glass factory. The glass industry is, apparently, the victim of a very curious system of nomenclature; thus the term "metal" is always applied to glass, while such curious terms as "ambitty" (spelt "anbitty" in some places in the book), "larrykin" and "cullett" are found in a short glossary at the end of this book. To the words named in that list Mr. Duthie should, however, have added another, which he employs, apparently, without being conscious of anything unusual—he refers to the process of etching away layers of glass as "aciding" the glass—and this can hardly be regarded as a welcome or even a legitimate addition to the language. Similarly, the continual loose reference to hydrofluoric acid as "fluoric acid" is not to be commended, although no doubt widely incorporated in workshop slang.

In spite of these criticisms, and some further

defects from the literary point of view, the book is to be welcomed as an addition to the scanty literature of glass from the pen of a practical glass worker, and it will no doubt find many appreciative readers among those interested in decorative glass. W. R.

ASTRONOMY, MYTH, AND LEGEND.

The Judgment of Paris, and some other Legends Astronomically Considered. By the Hon. Emmeline M. Plunket. Pp. iv+199; illustrated. (London: J. Murray, 1908.) Price 7*s.* 6*d.* net.

NO archæologist denies that in the "myth-making age" (whenever that may have been; we are still making myths now) our primitive ancestors were often struck with the appearance of the heavenly bodies, and made pretty stories out of them. But what he does deny is that, at any rate in the case of Greece, the majority of the myths, or anything like the majority, are of celestial origin. We know, also, far too much about the probable early history of the Ægean countries to believe for a moment that many Greek *legends* (as distinct from myths) are connected with the movements of the sun, moon, and stars. But the Hon. Miss Plunket finds an astronomical explanation for all legends as well as myths. She confuses the two; for her Achilles or Agamemnon are as unreal as Aphrodite and Hera, and all four are but symbols, so to speak, of some aspect of the heavenly bodies at some time or other.

To the Greeks Aphrodite and Hera were as real as Achilles or Agamemnon. Miss Plunket reverses the process. Both she and the Greeks are equally uncritical in their method! For her everything is unreal and astronomical. But why should not some of the myths, and a few of the legends, be astronomical, and the rest not? After all, we are not all of us star-gazing now, and there is no proof that our "myth-making" ancestors were more given to the pursuit than we are. An archæological discovery has shown us that many of these astronomical explanations of legend are mere fantasy, as we fear much of Miss Plunket's book is. There is far more earthy reality about these stories than she thinks. The murder of Agamemnon by Klytaimnestra and Aigisthos, in which Miss Plunket sees "mythically chronicled an eclipse occurring at or close to the season of the winter solstice," would be considered by the modern archæological historian to be a legendary reminiscence of a real tragedy of a particularly ghastly character perpetrated in the royal burg of Mycenæ at some time during the period of Achaian domination, no more. Why should it be anything else? Why be astronomical? Why should the Greeks have woven all these cryptic legends about stars?

To regard the Trojan war, too, as an astronomical myth after the discoveries of Schliemann is to exhibit a peculiar point of view. Miss Plunket calls it a "conviction." "Convictions" are unscientific; they are merely inverted prejudices, and no scientific worker has any business to be dominated by them. We note, however, from many indications, that Miss Plunket would be scientific enough could she but conceive the possibility that every myth and legend is not necessarily of astronomical origin. With her suggestion that the Gorgon's head is originally the cold full moon we are in cordial agreement. We have then in the Perseus story a queer folk-tale of a sort of Jack-the-Giant-Killer who went up into the sky and brought the moon down, as the primitive mind, like the child-mind now, could easily conceive the wonderful person as doing. In this there is nothing astronomical; and the Medusa on the shield of Athene may very well be the full moon on the body of the goddess of the grey-blue night-sky, *γλαυκῶπις Ἀθήνη*; why not? But there is no astronomical complication here, only a general sky-goddess with the moon on her, as it naturally would be. Miss Plunket's explanation of the term *Τριτογένεια* for Athene as "born of Trita," a deity of the Avesta, is at least more probable than the very doubtful connection with Lake Tritonis in Libya. The author makes other suggestions which will compel the most sceptical critic to read her work with attention and respect, even though he may differ *toto caelo* from its main contentions.

H. R. HALL.

HEAT FOR ENGINEERS.

Heat for Engineers. A Treatise on Heat, with Special Regard to its Practical Applications. By Chas. R. Darling. Pp. xii+430. (London: E. and F. Spon, Ltd., 1908.) Price 12*s.* 6*d.* net.

ANY author who attempts to cover the syllabus outlined in the preface and contents of this treatise needs considerably more than 415 pages of the ordinary-size text-book in which to do that properly. Too much has been attempted, and a great opportunity has not been made use of to the fullest advantage. Some portions of the book are elementary to a degree which irritates; other portions are so advanced that needful and useful sections have been sacrificed in order to keep the size of the book within the usual limits. Clearly the author should have divided his matter into two volumes, one elementary and the other advanced. In the preface there is rightly expressed the opinion that "the numerous applications of heat in modern industrial processes" . . . do not "receive more than the briefest mention in ordinary treatises on heat," and it is the avowed object of this book to remedy that omission. Yet "Practical Heat Engines" are disposed of in sixteen pages, and one searches in vain for a mention of that most interesting and instructive heat motor—the Diesel engine. There is nothing about evaporators; a study of the action of multiple-effect evaporators especially conveys much that is useful to the engineering student. We obtain the impression that the book is meant for the student in physics, and *not* for the engineer. If that is conceded, then there is more reason for its contents. In any case, however, space might have been found for dealing with the errors of the aneroid barometer, since the instrument itself is considered and described. An improvement in the arrangement of the contents

could be made with advantage. For example, pp. 119 to 136 contain some excellent matter on pyrometers. It is advanced work. From pp. 276 to 358 we are made to wade through much that is quite elementary on conduction, convection, and radiation!

There can be no question about the merits of two important sections of the book, viz. the chapter on calorimetry and that on pyrometry. Here the author is clearly doing work which pleases him, work with which he is both theoretically and practically well acquainted, and work which is done in a manner worthy of all praise. We can recommend our engineering students and our practical engineers to obtain the book for the contents of these two chapters. Great care has been expended throughout in the preparation of the text, and although a few of the illustrations might have been improved upon, yet they are, taken on the whole, good.

As we have suggested above, the title is misleading. The engineer will expect to be able to do without any other text-book on the theory of heat engines. He will, however, require some other manual, and he will find, in consequence, much overlapping. It must be made quite clear that the contents of "Heat for Engineers" is well written. The author has evidently devoted much labour and thought to the preparation of the book. Considered individually, each chapter is excellent. The above suggestions have been made in no carping spirit, but in the earnest hope that engineers will obtain fuller benefits in the shape of a more practical text-book from one who clearly is capable of helping them to understand difficult problems.

C. A. SMITH.

HIGHWAY ENGINEERING.

Highway Engineering. By Chas. E. Morrison. Pp. v+315. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 10s. 6d. net.

A Text-book on Roads and Pavements. By F. P. Spalding. Third edition, revised and enlarged. Pp. x+340. (Same publisher.) Price 8s. 6d. net

THE first-named of these treatises on highways was prepared by the author, who is professor of civil engineering at Columbia University, for the students there, "with a view to furnish a text in which the fundamentals of the subject should not be buried in a mass of detail," and the endeavour has been "to outline and emphasise the basic principles which are essential to good highways."

The book is divided into ten chapters, dealing respectively with road resistance; roads made of earth, gravel, broken stone and other materials; the design of streets, and paving with stone, bricks, asphalt, and wood. It contains a great deal of useful information, especially to engineers having to deal with roads in new countries. The elementary principles of road-making are clearly set out, and copies of specifications suitable for different classes of roads are given. The illustrations are numerous and clear, and in some cases graphic, as, for example, the relative load that can be drawn with the same tractive force on different kinds of road is shown by the number of horses required to draw the same load, this number varying from half a horse on a first-class road to ten on an earthen track.

With regard to the repairs of macadamised roads in rural districts, the author emphasises the fact, recognised by all experienced road engineers, that

"the best results are obtained at a less cost by a system of continuous small repairs, and that to keep a road in an efficient manner, incessant vigilance is required, any signs of ruts or hollows being at once filled up."

As to trees by the side of roads, the author points out that, whatever may be the disadvantages of road-side trees, it has been the practice in the most progressive road-building countries to plant trees by the roadsides. In France all roads having a width of 33 feet or over have a single row on each side, generally at distances varying from 16 to 32 feet apart. In some countries in the rural districts fruit trees are planted for which the road authority derives a revenue by the sale of the privilege to gather the fruit.

It may also be here mentioned that at the recent road conference at Paris it was agreed that, with a view to dust prevention, the planting of trees along the sides of the roads should be encouraged.

The effect of motor traffic on the surface of roads, and the great dust question, which at the present time are receiving so much attention both by the users and the road authorities, occupy only a small space in this book. The oiled roads that are in use in some districts in the United States are, however, more fully dealt with. With the object of preserving the surface of the road and preventing dust in dry weather, oiled roads are in operation over several hundreds of miles in California and other States. The cross-section of roads subjected to this process is graded to an inclination of half an inch to a foot. Before being treated with the oil the surface is sprinkled with water, then rolled with a light roller, after which a harrow having three-inch teeth is drawn over the surface. The oil is then spread from a specially designed tank cart at a rate varying from 8500 to 18,800 gallons to a mile of road 16 feet in width, or, say, from one to two gallons per square yard. Oils having an asphalt base are best suited for the purpose, but all petroleums are used. The surface of a road treated in this way is fit for the traffic twenty-four hours after being dressed, and is found to be impervious to rain-water, the surface remaining hard and firm also in hot weather.

The use of bricks for road paving, so frequently met with in Holland, has been introduced into America, especially in the smaller towns, the popularity of this form of paving being indicated by the fact that in a period of ten years, out of all the hard paving material used, 33 per cent. was of brick, 43 per cent. of asphalt, 10 per cent. of granite, and 9 per cent. of wood. The advantages claimed for bricks as a paving material are: a good foothold for the horses, efficient traction, durability under moderate

traffic, absence of noise, and ease in cleaning and repairs.

The second of the books under notice is a third edition, the first having been published in 1894. The aim of the author is

"to give a brief discussion, from an engineering standpoint, of the principles involved in highway work, and to outline the more important systems of construction, with a view to forming a text which may serve as a basis for a systematic study of the subject."

The edition now published has been largely revised, and professes to represent the best recent practice in highway work in the United States of America.

The book is divided into eleven chapters, two of which deal with "country roads," the information in which may be of service in our colonies and in new countries. The other chapters treat of road economics, drainage of streets and roads, macadamised roads, road foundations, brick pavements, bituminous pavements, stone and wood-block paving, and city streets. The information given is practical and useful, and covers very much the same ground as the book previously noticed. In the first chapter the author refers to statistics obtained by the Road Enquiry Office of the United States department concerning the cost of hauling farm produce to market, with the view of basing upon the figures obtained some conclusion as to the average saving resulting from the improvement of roads. The general conclusion arrived at appears to have been that, where the surface of an earth road is macadamised, the load that can be transported by the same number of horses may be doubled, if the earth road be dry and level; but where it is in a wet and rutty condition the load may be increased four- or five-fold. In many instances the economic advantage to an agricultural district may, by allowing the hauling to be distributed over the whole season, amount practically to a saving equal to nearly the entire cost of hauling by permitting the work to be done at times when other work is impossible

With regard to the use of oil for preserving the surface of macadamised roads and for the prevention of dust, the author fully confirms all that is said in Prof. Morrison's book. The quantity of oil used, according to the author's experience, is about the same as that given by him. The results obtained by this process are deemed so satisfactory that the use of oil is largely extending.

The author refers to the use made by the French road engineers of tar, either as a sufrace dressing or as tar macadam for the purpose of eliminating dust. It has been found that the cost of maintenance of roads so treated is considerably reduced, the dust nuisance is minimised, and the life of the road prolonged. The quantity of tar used for dressing the surface averages about one-third of a gallon to a square yard. The application of the tar is made about once in two years. At the recent road conference held at Paris, the conclusion was arrived at that tar-spreading on the surface of macadamised roads, when properly carried out, is an effective means of preventing dust, and that it also protects the road surface against the destructive action of traffic generally, and specially of motor-cars driven at high speeds. The tarring of the main roads, where this system has been carried out in this country, has also been found to be very effective in preventing dust.

PURE AND ANALYTICAL GEOMETRY.

(1) *Modern Geometry.* By C. Godfrey and A. W. Siddons. Pp. xvi+162. (Cambridge: University Press, 1908.) Price 4*s.* 6*d.*

(2) *The Analytical Geometry of the Conic Sections.* By the Rev. E. H. Askwith, D.D. Pp. xiv+443. (London: A. and C. Black, 1908.) Price 7*s.* 6*d.* net.

(1) THIS book is an interesting introduction to the ideas and methods of modern geometry so far as required for the special examination in mathematics for the ordinary B.A. degree at Cambridge. It deals with certain properties of triangles and of groups of circles, with chapters on harmonic section, pole and polar, similitude, inversion, orthogonal projection and cross-ratios, with a glimpse at the principle of duality both in a plane and in space, but not dealing much with the properties of conics except in the interesting chapter on orthogonal projection. There is a good table of contents, and an index which is of great assistance in finding where any subject is treated.

The book contains a number of theorems, but is written largely on the heuristic principle, as in many cases proofs of theorems are left to the reader, and in some cases important theorems are to be found only among the examples; *e.g.* the fact that if (AB, CD)=(AB, DC) the range is harmonic seems only to be given in Ex. 525 on p. 124. Such examples, which are mostly in thick type, must be treated as additional theorems.

The method of selection of theorems, especially in the early part of the book, is not easy to understand. Thus, two trigonometric properties of a triangle are given, viz. $a/\sin A = b/\sin B$, &c., and $a^2 = b^2 + c^2 - 2bc \cos A$, why is not obvious, as they are contained in any trigonometry. It seems a pity that the latter formula is not proved straight from Pythagoras instead of being merely borrowed from Euclid, Book ii. It would be much more instructive, and would illustrate the use of signs in dealing with segments of a line as discussed in the authors' first chapter.

The great charm of the book lies in its suggestiveness and in the excellent collection of examples, many of which are arranged so as to lead up to the theorems following them. The conciseness of the book will probably prevent it from being the sole text-book, but on the other hand will be of great use in fixing the student's attention on the leading theorems of the subject, and in enabling him to master them. The authors avoid any use of imaginary points, evidently thinking them unsuited for beginners.

(2) This fascinating book is the most complete text-book on the subject since the great work of Dr. Salmon. It is too difficult to be read as a first book, but for more advanced students and for a university course it is likely to be the standard book. The order in

which the various systems of coordinates are considered is in some respects rather curious, *e.g.* tangential equations are not dealt with until the last chapter but one, after discussions on cross-ratios and involution and a chapter on invariants, the succeeding chapter being on covariants. After Miss Scott's brave and able attempt to introduce tangential coordinates to beginners, this seems rather a retrograde step.

Then areal coordinates are introduced before trilinears, because in the majority of cases the resulting equations are so much simpler than the corresponding trilinear equations. In spite of one's sympathy with the reasons, and one's pleasure in the author's treatment of areals, it seems a pity to depart from the historical order, which introduced the student first to abridged notation, which slid so naturally into trilinears, thus preparing the student for appreciating the greater simplicity of areals.

Indeed, in the present book the abridged notation that was so charmingly put in Salmon's treatise is to be found only in scattered places, with no great emphasis placed on it, at any rate until the fifteenth chapter. It is there, but it would need expert guidance for a student to appreciate it at its full value. In this respect, and in the treatment of reciprocation, Salmon's book should still be read. In fact, it is difficult to imagine a time when this incomparable treatise will cease to be a source of inspiration and a delight.

The great interest of the present book lies in its masterly treatment of innumerable problems, and the use that is made of determinants at every turn. The methods of the differential calculus are introduced as alternative to other methods, but are not made an essential part of the development of the subject, as one would rather have expected nowadays, when all scholarship students learn the elementary methods of the differential and integral calculus. Probably this subordination or avoidance of calculus methods is due to the requirements of the Cambridge course.

For scholarship work in schools, the better students could very profitably read a good deal of the earlier part, after they have mastered some easier book. In this respect it is somewhat like Dr. Hobson's invaluable treatise on trigonometry, only selected portions of which are within the range of reading of the majority of scholarship students.

OUR BOOK SHELF.

Formeln und Hilfstafeln für geographische Ortsbestimmungen. By Prof. Th. Albrecht. Vierte Auflage. Pp. viii+348. (Leipzig: Wilhelm Engelmann, 1908.) Price 20 marks.

THE object of this work, which has run through four editions, is to supply within a convenient compass the formulæ that are used most frequently in the determination of time, and of terrestrial coordinates, together with tables by which the application of these formulæ can facilitate the ordinary work of an observatory. But the author has contrived that the book should be more than the mere collection of formulæ and tables. In an illuminating introduction he considers the sources of error which are likely to affect each class of observation, and uses his familiarity with different processes to show how many of these errors can be eliminated or rendered harmless by due precaution in the manipulation of instruments or by judicious selection of methods of observation. In this way the treatise becomes a practical guide in those matters of which it treats. These include the formulæ involved in the reduction of observations made for the determination of time, latitude, longitude, and azimuth. The instruments may be used on the meridian, on the prime vertical, or in the vertical of the Polar Star; they may be altazimuths or zenith telescopes; each finds its suitable application here; similarly, the particular methods which have been suggested to meet practical difficulties are discussed with the thoroughness of the expert.

The chapter on clocks contains much useful information to which Prof. Wanach, of Potsdam, has contributed. The tables of refraction have received special attention, incorporating the Pulkowa results. The numerical values, which very properly are not continued below 80° of zenith distance, may not differ greatly from those of Bessel, but they are founded on more modern theories, and with improved values of the refraction constant. As might have been expected from the author's long connection with geodetic work, references connected with the problems of the determination of longitude and the figure of the earth are particularly full. Indeed, in the latter section some of the tables can hardly be brought under the heading of "Ortsbestimmungen" as usually understood, but the tendency of all such compilations is to increase by the addition of tables and formulæ which have only a very limited application. Such tables have the advantage of being at hand if wanted.

It seems less defensible to cumber the book by other tables with which observatories are equipped quite as conveniently and with greater completeness in other forms. Those tables which give the squares of numbers up to 1000, or of the logs. of numbers up to 1960, or of trigonometrical functions of angles with no great accuracy, seem to us to be hardly warranted in a work of this character. But we hasten to say that this superfluity is not gained at the expense of material more immediately connected with astronomical work, and so far as we have been able to test the care and accuracy exhibited in the compilation, it is possible to speak in the highest terms.

Human Speech, a Study in the Purposive Action of Living Matter. By N. C. Macnamara. Pp. xiii+284. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1908.) Price 5*s.*

MAJOR MACNAMARA'S object in writing this book is to trace the gradual evolution of the living matter found in the cerebral centres on which intelligent speech depends. This is truly a herculean task, and one from which most physiologists and psychologists would shrink; and yet the author has succeeded in producing a readable book, full of information, and in many places both interesting and suggestive. There is not much said about human speech, either as regards its nervous or muscular mechanisms, but the author approaches the subject from the standpoint of general biology. He traces the influence of stimuli on living matter, the effects of the accumulation of stimuli, the gradual evolution of the senses, the corresponding development in greater complexity of the nerve centres, more especially of those connected with the higher centres of vision and hearing, and the changes that coincide with the appearance of such psychic activity as we associate with the brains of man and the higher animals. Waves of sound, falling on the ear, "reach the living matter forming his centre of hearing in such a form that they become impressed on this matter." The sensori-motor auditory centres become related

to the living matter in the psychical areas of the brain, these react on the cerebral centre or centres for speech, and, in turn, these "play upon the nuclei of the nerves supplying the muscles of the vocal apparatus."

In supporting this thesis Major Macnamara shows a wide acquaintance with contemporary biology—indeed, to such an extent is this the case that the book can well be recommended as an introduction to this department of science. The only criticism that may be offered is that there is rather a redundancy of statement, and not infrequently an exposition of matters that are not quite pertinent to the subject in hand. As examples we may take the references to current speculations in physics, to Ehrlich's chain-theory, to the description of karyokinetic phenomena and the changes in the early ovum, and to the exposition of new and abstruse notions about reflex activity. No doubt the author has desired to take a wide and philosophic view of the whole subject, even at the risk of introducing matter somewhat irrelevant. Still, conciseness is a virtue worthy of cultivation. This is an excellent additional volume to the "International Scientific Series." The illustrations have been carefully chosen, and there is a good index.

J. G. M.

Exercising in Bed. By Sanford Bennett. Pp. 268. (San Francisco: The Edward Hilton Co., 1907.) Price 1.25 dollars.

IN the introduction to this book, the author explains that he had been a delicate child and had led a sedentary office life, so that at the age of fifty he was dyspeptic, his muscular system was flabby, he was prematurely old! By adopting the system of exercises detailed in the book, he claims that at sixty-seven he is a strong, healthy man, and has regained youthful vigour, and certainly the photographs reproduced illustrating his condition before and after treatment show a very marked contrast.

The author is an enthusiast, but the book is written in a moderate spirit which disposes to the acceptation of his views. He rightly claims that the functions of the body can only be carried on if they be used and exercised. Thus a gland or muscle condemned to inactivity atrophies; it is a physiological law that a certain degree of activity is necessary for the physiological integrity of an organ or tissue. In consequence various methods of physical culture are much in vogue, and are of considerable service in the development of the body and preservation of health, but tend to be unpopular owing to the time necessary to devote to them, and the individual who loves his bed cannot, or will not, rise early enough to carry them out. Mr. Bennett, however, declares that all the necessary exercises can be carried out while in bed, and we think he is right, and a quarter or half-hour may be well spent in healthy exercise without disturbing the ordinary routine. In some ways, in fact, the method has an advantage, as many muscles can be better exercised when lying than when standing, and in those who are getting on in years, perhaps with weak heart and diseased arteries, there is far less likelihood of over-strain. Combined with various movements, massage or rubbing of the muscles is advocated, and is very desirable.

A series of exercises is detailed in the book, illustrated in every case with photographs, by which the muscular system of all parts of the body may be exercised and developed, and most of them can be carried out without any extraneous apparatus. We have no doubt that the exercises suggested, if carried out, would be of considerable benefit, even if they did not actually rejuvenate or restore good looks, as the author claims.

R. T. H.

Cement Laboratory Manual. By Prof. L. A. Waterbury. Pp. vii+122. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 4*s.* 6*d.* net.

THIS is a book for the use of students who are learning the various physical methods of testing cement. In the main it consists of instructions for working out a series of "problems" by the learner during a course of laboratory tuition, as practised in the University of Illinois. The work is arranged much on the lines familiar to students of electricity at Finsbury under the late Prof. Ayrton, the operators working in classes with given apparatus and materials, and being furnished with directions how to carry out the experiments, how to record the results, and how to interpret them.

For comparison of the results with what would be required in actual practice two useful appendices are given. One contains the report of a committee of the American Society of Civil Engineers on the question of uniform tests for cement; the other is a report upon standard specifications for cement, by a committee of the American Society for Testing Materials.

Determinations of the degree of fineness, specific gravity, plasticity, soundness, time of setting, and tensile strength of cements are the chief experiments set out. These are regarded as suitable for class teaching, and a student who works carefully through the exercises should gain considerable insight into what is required in judging the values of cements by laboratory tests. The author, however, rightly points out that a considerable amount of practice, much more than is afforded by the laboratory course, is necessary to obtain uniformly satisfactory results.

Theoretical matters are not dealt with in the book. There are illustrations of the chief pieces of apparatus, and also some trivial pictures—a mason's trowel, a set of scales and weights, and similar things—which are a mere waste of space.

C. S.

"Saint" Gilbert: the Story of Gilbert White and Selborne. By J. C. Wright. Pp. 90. (London: Elliot Stock, n.d.) Price 2*s.* 6*d.*

THIS little book bears a most unfortunate title, for whatever may have been the virtues of Gilbert White, he was in no proper sense of the word a saint. He was an honest, excellent Englishman, with a "curious" intellect and a generous disposition, but assuredly not more saintly than a thousand others. Mr. Wright says in his preface that "it is permissible to regard him as the patron saint of the little village where he spent the greater part of his life." That is well enough, for it suggests no saintliness; but "Saint Gilbert" is most unhappy. The book consists of 85 small pages, largely made up of quotations from White himself and those who have recently written about him. It will do no harm, and may perhaps do some good; and that is perhaps all that need be said about it. The eight photographs which illustrate it are unusually good, and so are the tail-pieces at the end of the chapters.

Les Zoocécidies des Plantes d'Europe et du Bassin de la Mediterranée. Tome i. By C. Houard. Pp. 569; 1365 figures, 2 plates, and 4 portraits. (Paris: Hermann, 1908.) Price for both volumes, 40 francs.

DR. HOUARD deserves congratulation on the successful accomplishment of his task of giving a systematic account of the European galls. Of recent years there has been great activity in the study of galls, which are of equal theoretical and practical interest, and this scholarly and well-arranged catalogue, brought up to date, will be widely welcomed. It is an admirable piece of work. The author gives terse descriptions of

the galls, and refers (by name simply) to the gall-forming animals; he arranges the galls according to the families of plants affected; he supplies more than a thousand serviceable illustrations, a statement of the geographical distribution of each gall, and the indispensable bibliographical references. The second volume is in the press; the first volume deals with the galls of cryptogams, gymnosperms, monocotyledons, and the dicotyledons from Ranunculaceæ to Rosaceæ. The work will be a great boon to entomologists, botanists, foresters, and agriculturists. We hope that the author will not write *finis* to his *magnum opus* without discussing, as he is so competent to do, the fascinating biological problems which are raised by the study of galls, crowning his work of description with an essay of interpretation.

Practical Coastal Navigation, including Simple Methods of finding Latitude, Longitude, and Deviation of Compass. By Comte de Miremont. Pp. 88. (London: J. D. Potter, 1908.) Price 4s.

In this small volume Comte de Miremont has collected an enormous amount of useful information and what might be called tricks of the trade, which tell the young navigator everything that has been found useful in coastal navigation after years of experience.

The book is excellently arranged, and the explanations are simple. Besides the various chapters on actual coastal navigation, deviation and rule of the road, and weather forecasting in home waters, are most ably explained.

The book should find a place in every chart-house and navigation school. Comte de Miremont is to be highly congratulated on having produced such a useful aid to mariners, and to those wishing to become efficient in this particular art. H. C. LOCKYER.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Radiation of the Active Deposit from Radium through a Vacuum.

WHEN the radium emanation is transformed into radium A, the process is accompanied by the emission of α particles with a velocity of $1{\cdot}70 \times 10^9$ centimetres per second (Rutherford, *Phil. Mag.*, October, 1906). The portion of the atom from which the α particle has been emitted, which constitutes the radium A, must therefore be subjected to considerable shock and recoil in a direction opposite to that in which the α particle is projected. If we further consider that the mass of the α particle is $4(H=1)$, and that of the active deposit of the order 100, it follows that at the moment of its formation this product must be travelling with a velocity of the order 10^7 centimetres per second. In ordinary circumstances, when the emanation is mixed with air at atmospheric pressure, the radium A particle will possess only sufficient energy to permit it to travel a fraction of a millimetre before being stopped by collision with air molecules. On the other hand, at very low pressures, these particles should travel considerable distances without being stopped by the rarefied air, and come to rest on the enclosure containing the emanation. These particles should, in fact, constitute a type of very easily absorbed radiation. It has been the object of some experiments which we have recently performed to demonstrate directly the existence of this radiation.

The emanation from a fairly large quantity of radium was condensed at the bottom of a wide glass tube by immersing its end in liquid air. A brass plate, which just fitted into the glass tube, was suspended, in a high vacuum, a few centimetres above the condensed emanation so as to expose it to the bombardment of the active deposit particles being fired up the tube. After a suitable exposure the plate was removed, and its activity tested in the usual manner by a quadrant electrometer. The surface of the plate exposed to the emanation was always found to be highly radio-active.

Now this in itself would afford no evidence of the effect sought, for it is well known that when a large quantity of radium emanation is condensed in liquid air, the condensation is by no means complete, and there always exists in the vessel, above the condensed emanation, a considerable quantity of emanation in the gaseous state. A plate situated above the emanation as described above must therefore of necessity become radio-active on this account. But it was always found that the activity of the surface of the plate facing the emanation was greater than that of the opposite side, and it seems quite certain that this excess of activity is due to the direct radiation of the active deposit on to the plate. The ratio of the activity of the surface turned towards the emanation to that turned away from it has been found, under suitable conditions, to be as great as 50 to 1. The exact ratio obtained depends, of course, on a variety of experimental conditions, but in all circumstances the activity of the surface of the plate turned towards the emanation exceeded that of the reverse side. Moreover, by interposing a screen between the emanation and the plate, the excess activity collected on the surface of the plate turned towards the emanation could be completely obliterated. Experiments have been made at different pressures, and it has been found that the radiation is cut down to one-twelfth by traversing about 8 centimetres of air at a pressure of 1·15 millimetres of mercury. The same distance of air at 2 millimetres pressure is sufficient almost completely to stop the radiation.

These experiments give rise to a number of interesting questions which it is not yet possible to answer with any certainty. In the first place, it seems probable that when the emanation is condensed at the bottom of an evacuated tube, the attendant phenomena must be somewhat complicated, for when in radio-active equilibrium the emanation will be mixed with all its decomposition products. At every stage in the radio-active series at which α particles are expelled, some of the residual atoms should be fired up the tube. Although it is not yet possible to speak with certainty, it would seem that both radium A and radium B are projected up the tube on to the plate exposed to the radiation.

Another question of importance also arises as to whether the particles projected from the emanation are charged or not. Some experiments have already been made on this point with the object of deflecting the radiation by an electric field; but the difficulties are considerable, and no definite evidence has yet been obtained. We hope, however, that these difficulties will not prove insuperable.

S. RUSS
W. MAKOWER.

Physical Laboratory, The University, Manchester, January 9.

The Isothermal Layer of the Atmosphere.

IT seems to me that in NATURE of January 7 (p. 281) Mr. Dines successfully defends his simple, compact, but extremely efficient apparatus from the suspicions that have been levelled at it. The tests of the instrument before and after use show that it truly records the temperatures and pressures to which it is reduced. Mr. Dines is therefore entitled to call for adequate discussion of the most marked outcome of the experiments—the fact that in nearly all cases the minimum reading of temperature is reached long before the maximum height in the ascent, and long after in the descent. To suggest that the thermometer or the barometer may be slightly out is really to evade the problem.

Taking, then, the readings as fairly accurate, do they prove the "isothermal layer"? What are the circumstances? To the best of my knowledge they are these:—the instrument is screened by a polished metallic cylinder open at top and bottom, the centre of which it occupies, and the draught of air produced by the up-rush and down-rush of the balloon is relied on to ensure that the thermograph, which is of light metal strip, shall take the

temperature of the air with which it is in contact. It is hard to suggest a better arrangement for getting some notion of the low temperatures which the upper air appears to delight in producing and maintaining in the most trying circumstances; nevertheless, it is easy to show that the temperature of the instrument will differ from that of the air by a variable interval depending on the speed of the balloon, the density of the air, and the intensity of the radiation from earth, clouds, balloon, sun, air, and vapour.

Suppose I wish to take the temperature of the feed air below the fire-bars of a furnace. If the current of air were sufficient, and the screening of the thermometer almost perfect, I might get a close approximation, but if the draught relaxed in speed or density, or if the screening became less perfect, the thermometer would respond to the radiation by which it was surrounded and rise above the temperature of the air. A *ballon sonde* is such an apparatus. It is in a warm situation, but is surrounded by an intensely cold medium. It is a speck extremely close to a great warm planet, and bathed in his radiations and reflections—to say nothing of sun-rays, which sometimes complicate the problem. The screen is open to the earth below and to the balloon above, and the instrument, though screened itself, follows in the wake of the unscreened balloon and is fanned by the air that has passed over its heated surface.

In the ascent the thermometer reading falls briskly, and soon reaches a figure which may be 100° or more below what it would stand at if it were screened *from air currents* for a few minutes; but this gap between the temperature of the instrument and the temperature proper to its position cannot be extended indefinitely. The up-rush of the balloon attains a maximum velocity and declines, and the density of the air also rapidly diminishes. When the receipt by radiation equals the loss by conduction, the thermometer has reached its minimum, and enters the so-called "isothermal layer," the regularity of the occurrence of which on the traces is due to the similarity of pattern of balloon and outfit and of the other circumstances. I know that Mr. Dines contends that speed upwards or downwards can have no effect on the thermometer, but he takes no account of the circumstance that heat is constantly entering the instrument, and that it is solely the current of air that keeps down its temperature by removing the intruding heat.

It seems a pity that the following question stands barred:—Why *is* the material *Air* so cold where the material balloon and other instruments *would be* so warm?

R. F. HUGHES.

16 Westmoreland Street, Marylebone, W., January 9.

IF all balloon ascents had been made by day, I confess that I should be inclined to agree with Mr. Hughes and think that the recorded temperatures were due to radiation, but that idea is disposed of, to my mind, by the fact that the isothermal column of air shows just as plainly in ascents made after sunset as in those made in the day. At night the thermograph must receive some heat by radiation from the earth, and lose some by radiation into space, but both amounts must be infinitesimal in comparison with that which would be given to it by the sun. If, then, exposure to the sun does not seriously alter the temperature, and it does not do so even at the greatest height provided there is a moderate amount of vertical motion, the effect of the radiation after sunset must be utterly insignificant. That solar radiation in the ordinary conditions is not important is proved by the fact that if the balloon bursts, and therefore does not float, it is not possible to say from the trace alone if the ascent was by night or by day. There have been cases in which the balloon did not burst, and the temperature at the top reached the freezing point of water. If I asserted that the rate of ascent does not matter, I must plead guilty to a mistake, but I think I said "apart from radiation," and I still believe that radiation at night to and from the bright metal of the thermograph is so trifling that the rate of ascent is of no consequence. There is also the fact that the up-trace, where the motion is comparatively slow, is identical with the down-trace where the motion is rapid.

W. H. DINES.

An Electromagnetic Problem.

SINCE the solution of the problem put forward by Prof. Comstock in NATURE of November 19, 1908, is apparently not obvious to everyone, will you permit me to point out that, so far as I can see, the difficulty arises, not from any peculiarity of the laws of electromagnetism, but from a simple misconception of the meaning of dynamical terms?

Prof. Comstock says that when an electrified sphere expands it loses electrostatic energy, but does not gain either kinetic energy (for the sphere has no mass) or magnetic energy (for the resultant field due to the motion of all parts of the sphere is everywhere zero). Now the energy of a conservative system, such as is considered, is measured by the amount of work which it can do on some external system in passing from its original to some defined final state; the amount of the work which can be done, and therefore the amount of the energy, will vary according to the external system which is chosen, and the principle of the conservation of energy will be true only if the same external system is taken in measuring the amount of work that can be done at various times during the change.

When he states that the magnetic energy of the expanding sphere is zero, Prof. Comstock is taking as his external system, on which work is to be done, a system unconnected with and independent of the expanding sphere; but the electrostatic energy of the sphere with respect to such a system is quite unaltered by the expansion, if the system is either wholly within or wholly without the sphere throughout the expansion, and the change in the electrostatic energy which ensues, if any part of the system passes through the surface of the sphere during the expansion, is independent of the discreteness or continuity of the electrification on the sphere, and perfectly consistent with the conservation of energy. Adopting such an independent system as that on which work is to be done, there is no relevant change in either the electrostatic or the magnetic energy.

On the other hand, when he says that the sphere in expanding loses electrostatic energy, Prof. Comstock is taking as the system on which work is to be done part of the expanding sphere or some system connected rigidly therewith; but then it is clear that in estimating the magnetic energy no account must be taken of the magnetic field due to the motion of this part. Leaving out of account the magnetic field due to this part of the sphere, a simple calculation shows that the magnetic field due to the motion of the rest of the sphere relatively to this part is *not* zero everywhere, but that the value of $\mu H^2/8\pi$, integrated throughout the entire field, is equal to the value of the electrostatic energy with reference to this part lost in expansion.

NORMAN R. CAMPBELL.

Trinity College, Cambridge, January 16.

Radium in the Earth.

IN the discourse entitled "Radio-active Changes in the Earth," delivered at the Royal Institution by the Hon. R. J. Strutt, and printed in NATURE of December 17, 1908, the lecturer advanced the opinion that the mineral beryl contained an hitherto unknown element from which the comparatively large quantity of helium present is generated.

This interesting and remarkable conclusion has induced me to direct attention to a statement which occurs in a paper entitled "The Heat of Formation of Glucinum Chloride," by J. H. Pollok (Chem. Soc. Trans., 1904, p. 603). Mr. Pollok prepared a large quantity of basic glucinum carbonate from 2000 grams of beryl, and during the preparation of this compound he detected the presence of another substance, the nature of which he was not able to ascertain. His statement is as follows:—"This precipitate consisted chiefly of iron, zinc, and nickel sulphides, but another substance appeared to be present; its amount was, however, too minute to admit of any satisfactory conclusion being drawn regarding it. This sulphide has also been observed by Kruss and Moraht."

PERCY EDGERTON.

The Laboratories, 61 Cornhill, London, E.C.,
December 31, 1908.

PRIMITIVE MAN IN THE KESSLERLOCH.[1]

THAINGEN is known to most of us only as a little station on the line from Schaffhausen to Constanz. In the Jurassic limestone that rises above

FIG. 1.—Excavations at the main entrance to the Kesslerlcch in 1902.

the village, there is, however, a famous cavern, which in the last thirty years or so has added greatly to our knowledge of Palæolithic man.

The Kesslerloch has suffered by being somewhat too accessible. It is even visible from the railway embankment, and has attracted workers, discreet and indiscreet, from several of the adjacent towns. We owe to Konrad Merk, a schoolmaster in Thaingen, the recognition of the cave as a place where prehistoric records might be found. In December, 1873, Merk and a friend named Wepf began their excavations in frozen soil. Wepf took a number of worked flints and a carving in reindeer-horn to Prof. A. Heim, in Zürich. On January 6, 1874, Heim himself visited the cave, and found the beautiful incised drawing of the grazing reindeer, which is now so well known through many reproductions.

The present handsome memoir brings together the discoveries made from time to time, including those of Dr. J. Nüesch in 1898 and 1899; but it deals especially with the systematic excavations organised (p. 27) by the Schweizerische naturforschende Gesellschaft and the Historisch-antiquarischer Verein of Schaffhausen in 1902 and 1903. Dr. Heierli, of Zürich, was appointed as director, and a very complete investigation has been carried out. Merk published his results in 1875, and an English translation appeared in the following year in London. Drawings of a bear and a sitting fox, incised on bone, were included among the objects found in the detrital heaps, and the originals are now in the British Museum. They are again figured in the present memoir (plate xxix.) as a warning to collectors. The true drawings made by Palæolithic man at Thaingen are worked on polished reindeer-horn, or rarely on jet (p. 196); and the bear and fox are certainly in another style of art. Lindenschmit, director of a museum in Mainz, and well acquainted with prehistoric art, soon pointed out that the bear and fox were copied from a book for children that had appeared in 1868. Forthwith a judicial inquiry succeeded in tracing the fraud to an artful workman and an innocent schoolboy; but for a time suspicion fell upon other and far superior specimens. Heim, however, who is here quoted in full, proved his case for the reindeer; a pig that had somehow got figured with a curly tail was shown to have a most proper and straight one in the original; and the carved head of a musk-ox, one of the most valuable relics (plate xxxii.), has proved especially convincing. In fact, only three forgeries are now recognised, thanks to the very searching criticism which each object has undergone. On plate xxxii., by the by, the numbers 5 and 6 should be interchanged.

Dr. Heierli's own excavations were in the yellow loam, which must have accumulated during the epoch of the occupation of the cave by man (p. 60). The hearths in this show that successive groups of settlers came in, but all the remains are classed as Palæolithic, and mostly as Magdalenian. There are no signs of climatic alteration during this epoch (p. 213); but the water-level in the loam has now climbed some four metres higher than when the cave was first inhabited. The loam is regarded by Prof. Meister as accumulating, partly

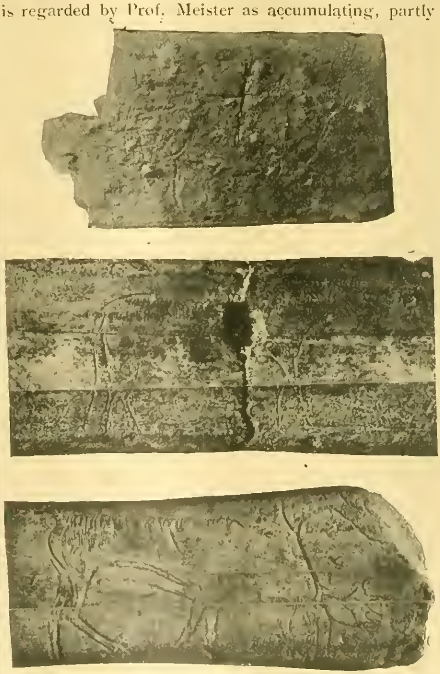


FIG. 2.—Incised drawings on reindeer horn, from the Kesslerloch. The two lower photographs are from casts in which the curved surfaces of the horn are brought into one plane.

[1] "Das Kesslerloch bei Thaingen." By Dr. J. Heierli, with the co-operation of other authors. Pp. vi+214; with 32 plates. (Zurich: Neue Denkschriften der schweizerischen naturforschenden Gesellschaft. Band xliii., 1907.)

in a shallow stream, while the last extension of the Rhine glacier withdrew from northern Switzerland (p. 56).

A full account is given by Prof. Hescheler of the animal remains, which include representatives of the lowland fauna of pre-Glacial times, of an Arctic or Alpine fauna, now known to have been strongly present, and of a fauna proper to the Magdalenian epoch, suggesting steppes and tundras. The cave-dwellers fed mostly on reindeer, hare, horse, and ptarmigan, and probably had no domesticated animals. Among the more interesting remains found may be mentioned those of the mammoth, the lion, the woolly rhinoceros and the musk-ox. G. A. J. C.

THE NEW IMPERIAL INSTITUTE.

WE imagine that few, if any, members of the old Corporation of the Imperial Institute, which was dissolved by Act of Parliament in 1903, believed that within a very few years the institute would be able to produce the record of useful work which has just been presented to Parliament.[1] The policy at first adopted, and persisted in long after it had been discredited, led to a failure, in so far as the complete fulfilment of the objects for which the institute was founded was concerned, and lent plausibility to the view that South Kensington was too "inaccessible" to become a centre of scientific and commercial information concerning the raw materials of the Empire. It has been amply proved, however, now that the original failure was not due to this cause. South Kensington is no longer inaccessible, and in any case the exact position in London of a central establishment, which has to be in close touch with distant parts of the Empire, whence its work chiefly comes, as well as with manufacturers throughout the United Kingdom, is a matter of secondary importance. Whatever may be urged against the South Kensington site, it has not stood in the way of the accomplishment of an increasing volume of work which, it is clear from the present report, must have taxed to the utmost the power and capabilities of the relatively small staff allotted to the institute.

The new era dates from 1903, when the Imperial Institute was transferred to the Government and placed under the control of the Board of Trade, with Prof. Dunstan as its new director. This Government department seems, however, to have been primarily interested in developing in the city a Commercial Intelligence Office, and appears to have done little to facilitate reconstruction at South Kensington. The institute made steady if slow progress during this period, as shown by the report on its work presented to Parliament in 1906, and received increasing support from the colonies, with the result that in 1907 its management was delegated, under the Act of 1903, to the Colonial Office, representation on the board of management being given to the India Office and the Board of Trade.

It may be claimed that the present measure of success is the result of steady and persistent work on scientific lines, and is indeed the outcome of the foundation in 1896 of the scientific and technical department, with the assistance of the Royal Commissioners of the Exhibition of 1851, who, however, ceased to contribute to the support of this department when the institute was transferred to the Government.

The present report deals with each of the several divisions of the work carried on, but we need only refer to that of more immediate scientific interest. This concerns the operation of the institute in conducting investigations and inquiries relating to the commercial utilisation of the raw materials of the Empire.

This work has benefited the British manufacturer, as well as the colonial producer, as is shown by many instances quoted in the report. It is obviously of first importance that this scientific work should be directed to practical ends and made to tell commercially, so that, as a rule, the results are of technical and commercial rather than of purely scientific interest. Nevertheless, the members of the scientific staff have made a very creditable contribution to more purely scientific knowledge, no fewer than thirty communications to the Royal and other scientific societies being noticed in the report. These relate chiefly to the results of researches on the constituents of new vegetable and mineral products. The material placed at the disposal of the institute is so valuable and important, from this point of view, that, in the interests of science, it would be a wise step for the Colonial Office to enable the scientific members of the staff to devote more time to such investigations as these, most of which can only be undertaken successfully by such men with special training and experience, who are at present deterred from undertaking it by the pressure of routine work.

We observe that satisfactory working arrangements have been concluded with agricultural and other technical departments in the colonies, by which only such investigations are conducted at the institute as require special knowledge and experience, or are of a technical character needing reference to manufacturers at home. The colonies are thus left free to devote attention to such work as can best be accomplished on the spot, whilst relying on the Imperial Institute for the conduct of investigations which can most usefully be carried out by a central department at home.

Brief mention may also be made of two other branches of activity.

The "Bulletin of the Imperial Institute" serves as a medium for the publication of the more important official reports of investigations, and also for the dissemination of information respecting developments in tropical agriculture and the utilisation of raw materials. This quarterly publication is stated in the report to have a large and increasing circulation in this country and the colonies.

The public exhibition galleries contain exhibits representative of the natural resources of practically all parts of the Empire. Their reorganisation has been in progress since 1903, and new products, maps, statistical diagrams, &c., are continually being added, with the view of rendering the "Court" allotted to each British possession as representative as possible of its present economic development. The report mentions that special facilities are now afforded to schools, with the object of rendering the exhibition galleries useful as a means of teaching the geography of the colonies and India, and that these facilities are being taken advantage of to an increasing extent.

The Imperial Institute in its new *régime* still suffers to some extent from the prejudice created by its false start. Now that it has justified its existence and shown that it can render services of great importance to the Empire, it may be expected that something further will be done to strengthen its general and financal position. The present report shows that its operations are hampered for want of space. The arrangements made with the Government by the former corporation included the occupation of a portion of the building by the administrative offices of the University of London. In view of the increasing need, both of the university and the institute, for adequate accommoda-

[1] Report on the Work of the Imperial Institute, 1906 and 1907. Colonial Reports—Annual Series, No. 584. By Prof. W. R. Dunstan, F.R.S.

tion in which to carry on their work, which, though entirely different in character in the two cases, is of great importance to the nation, the situation will before long require reconsideration, as new conditions have arisen since the arrangement was entered into in 1903.

BALTIMORE MEETING OF THE AMERICAN ASSOCIATION.

THE sixtieth annual meeting of the American Association for the Advancement of Science and of the several affiliated societies was held at Baltimore, Md., on December 28, 1908, to January 2, 1909. In practically all respects the meeting was the most successful in the history of the association. It was the largest meeting ever held, and the total attendance is estimated at about 1800. In addition to the several sections of the association, important meetings were held by the following bodies:—

The American Society of Naturalists, the American Society of Biological Chemists, the American Anthropological Association, the American Folk-lore Society, the American Philosophical Association, the American Physical Society, American Psychological Association, American Physiological Society, American Society of Vertebrate Palæontologists, the American Chemical Society, American Society of Zoologists, American Nature-study Society, American Mathematical Society, the American Federation of Teachers of the Mathematical and the Natural Sciences, American Institute of Electrical Engineers, American Alpine Club, Association of American Geographers, Association of Economic Entomologists, the Botanical Society of America, the Entomological Society of America, Geological Society of America, Society of American Bacteriologists, Association of American Anatomists, Southern Society for Philosophy and Psychology, the Sullivant Moss Society, and the Wild Flower Preservation Society.

The address of the retiring president of the association, Prof. E. L. Nichols, of Cornell, was entitled "Science and the Practical Problems of the Future," and was printed in an abridged form in last week's NATURE. It was an address of very broad bearing, written by an eminent physicist and at the same time by one engaged in university work. It contained a strong plea for research work in pure science at the universities. The addresses of the vice-presidents, that is, presidents of sections, were all upon important topics. Vice-president Wilson, before the section of zoology, spoke on recent researches on the determination and heredity of sex; Vice-president Talbot, before the section of chemistry, spoke of science teaching as a career; Vice-president Crowell, before the section of social and economic science, spoke on the influence of science on investments; Vice-president Lovett, in mathematics and astronomy, had for a title "The Problem of Several Bodies: Recent Progress in its Solution"; Vice-president Miller, before the section of physics, spoke on the influence of the material of wind instruments on the tone quality; Vice-president Bessey addressed the botanists on the subject of the phyletic idea in taxonomy; Vice-president Hektoen, before the section of physiology and experimental medicine, spoke of opsonins and other anti-bodies; Vice-president Boas addressed the section of anthropology and psychology upon the important topic of race problems in America; and Vice-president Landreth, before the section of mechanical science and engineering, spoke of governmental control of public waters.

The addresses all through the meeting assumed in general an aspect of great interest. Dr. Bogert's address as retiring president of the American Chemical Society was on the subject of the function of chemistry in the conservation of natural resources; Prof. Muensterberg, as president of the American Philosophical Association, spoke on the problem of beauty; the address of the president of the American Society of Naturalists, Prof. Penhallow, of McGill University, was entitled "The Functions of the American Society of Naturalists"; Vice-president Brown, before the section of education, dealt with world standards of education.

The public addresses were of extreme interest. Prof. E. B. Poulton, F.R.S., of the University of Oxford, addressed a large audience on the subject of mimicry in the butterflies of North America; Dr. Albrecht Penck, of the University of Berlin, spoke on the same night before an equally large audience on man, climate, and soil; Mr. W. A. Bryan, of Honolulu, gave a public lecture on a visit to Mount Kilauea, illustrated by moving pictures—this address was appropriate in view of the proposed visit of the association to Hawaii in 1910. An important feature of the meeting was an address by Major Geo. A. Squier, of the United States Army, before the section on mechanical science and engineering, on the subject of recent progress in aëronautics, which was followed by the decision of the section to devote special attention to the field of aëronautics in its future work.

Several symposia of great interest were held during the meeting. That given under the auspices of the section on social and economic science, on the subject of public health, was listened to by a large audience, and included papers by Dr. Wiley, on the nation's pure food problem; by Dr. Howard, on the economic loss to the people of the United States through insects that carry disease; by Mr. Horace Fletcher, on vital economics; by Prof. Irving Fisher, on the movement for health reform; and by Surgeon-General Wyman, on public health administration. The same section held symposia on tariff reform and on stock exchange regulation. An important symposium was held under the section of physiology and experimental medicine on the regulation of physical instruction in schools and colleges from the standpoint of hygiene. The section on geology held a symposium on the subject of correlation, in which the most eminent geologists of the United States took part, and the section on physics held a session at which papers of general interest to scientific men of other specialities were presented.

Possibly the event of greatest general interest was the Darwin memorial day programme, held on Friday, January 1. Prof. E. B. Poulton, F.R.S., was present from England at the invitation of the association to take part in the exercises of the day. Introductory remarks were made by the president of the association, Prof. T. C. Chamberlin, of the University of Chicago, and the following addresses were given:—

The theory of natural selection from the point of view of botany, by Dr. John M. Coulter, of the University of Chicago; fifty years of Darwinism: past and future experimental work bearing on natural selection, by Prof. E. B. Poulton, of Oxford University; the cell in relation to heredity and evolution, by Dr. E. B. Wilson, of Columbia University; the direct effect on environment, by Dr. D. T. MacDougal, of the Carnegie Institution of Washington; the behaviour of unit characters in heredity, by Dr. S. W. E. Castle, of Harvard University; mutation, by Dr. Chas. B. Davenport, of the Carnegie Institution of Washington; adaptation, by Dr. Carl H. Eigenmann, of the Indiana University; recent palæontological evidence of evolution, by Prof. H. F. Osborn, of Columbia University.

These addresses will be published in a memorial volume, together with the following addresses, which were on the programme, but were not read owing to the necessary absence of the authors:—

Determinate variation, by Dr. Chas. O. Whitman, of the University of Chicago; the isolation factor, by Dr. David Starr Jordan, of Stanford University; evolution and psychology, by Dr. G. Stanley Hall, of Clark University.

At night on Friday, January 1, a Darwin memorial dinner was given, attended by about 300 naturalists. Following the dinner, addresses were given by Dr. W. H. Welch, on the debt of medicine to Darwin; by Dr. Albrecht Penck, on the geographical factor in evolution; and by Prof. E. B. Poulton, on Darwin's life and character. Prof. Poulton was particularly happy in his address, and his visit to America at this time and for this purpose was a great gratification to all the members of the American Association. At the close of the dinner a congratulatory telegram was sent to Dr. Alfred Russel Wallace.

The association decided to meet in Boston during convocation week, 1909–10, and the following plans were laid for future meetings: 1910–11, Minneapolis; summer of 1910, Honolulu; 1911–12, Washington; 1912–13, Cleveland; 1913–14, Toronto. The following officers for the coming year were elected:—

President: David Starr Jordan, Stanford University; *Vice-presidents:* Section A, E. W. Brown, of Yale University; Section B, L. A. Bauer, of Carnegie Institution; Section C, Wm. McPherson, of Ohio State University; Section D, J. F. Hayford, of U.S. Coast and Geodetic Survey; Section E, R. W. Brock, director of the Geological Survey of Canada; Section F, W. E. Ritter, of University of California; Section G, D. P. Penhallow, of McGill University; Section H, Wm. H. Holmes, of Bureau of Ethnology; Section I, Carroll D. Wright, of Clark College; Section K, C. S. Minot, of Harvard University; Section L, James E. Russell, of Columbia University; *General Secretary:* Dayton C. Miller, of Cleveland; *Secretary of the Council:* F. G. Benedict, of Carnegie Institution.

Among the resolutions of general interest passed by the council were one protesting against special legislation against vivisection; another requesting Congress to do away with tariff on scientific books, instruments, and apparatus; and a third requesting Congress to enlarge the scope of the National Bureau of Education.

Much pleasure was expressed during the meeting at the very courteous action of the British Association in making the officers of the American Association honorary members for the coming Winnipeg meeting, and in offering to the fellows and members of the American Association membership in the British Association for the meeting on the same terms as old members of the British Association, including the receipt of the report of proceedings of the meeting. It seems certain that there will be a large attendance of members of the American Association at the Winnipeg meeting.

THE PROMOTION OF RESEARCH.[1]

THE question of the promotion of research is one which makes a very direct appeal to scientific men, most of whom have at some time or other been confronted with the difficulties raised by it. In a little volume which has reached us a scheme is outlined for the promotion of scientific research, under which public money may be awarded to persons making discoveries prescribed by Parliament. According to the scheme, any person who has made such a discovery may apply for a grant, the application being accompanied by a specification of the discovery. The specification is examined for formalities and for novelty of subject-matter, and afterwards all the specifications accepted in one year are submitted to an investigation as to the nature and novelty of all the discoveries for that year, grants being then made in relation to the discoveries which comply with the terms prescribed by Parliament.

It will be seen from this brief statement of the scheme that it bears a close resemblance to the grant of Letters Patent to inventors, and, in fact, the scheme is based on the Patents Acts. The patent law enables an inventor to obtain a grant, not of money, but of a monopoly, for a limited time, and by somewhat similar procedure the scheme enables a person making a discovery prescribed by Parliament to obtain a grant, not of a monopoly, but of money. There can, unfortunately, be no doubt that many discoverers have hitherto met with very inadequate remuneration, and that some have not been recognised at all. While it is doubtful whether the establishment of such a scheme would enable discoverers to be remunerated adequately, it would certainly provide for the recognition by the State of "true and first discoverers," and to this extent at least would diminish injustice and encourage scientific research. It might also exert a powerful, though indirect, effect on manufacture, for if such a scheme had been established, and if Parliament had prescribed, say, discoveries relating to glass for optical instruments, how different might have been the position to-day of English manufacturers of optical instruments.

The adoption of such a scheme could without doubt be utilised to accelerate the solution of some of the important problems of physical and chemical science, and many of the life and death problems of medical and biological science.

[1] "A Scheme for the Promotion of Scientific Research." By Walter B. Priest. 2nd edition. Pp. iv+64. (London: Stevens and Sons, 1908.)

AN INVESTIGATION OF THE SOCIOLOGY AND RELIGION OF THE ANDAMANESE.

THE inhabitants of the Andaman Islands have long been recognised as one of the most primitive races of mankind. By their geographical position and their ferocity towards strangers, they were practically isolated from the rest of the world until 1858. The tribes of the Great Andaman, which constitute by far the largest part of the whole race, are rapidly diminishing in numbers, and are fast forgetting their ancient lore; the next half-century will witness their entire extinction. It was thus highly desirable that a full investigation should be made of these interesting pygmies before it was too late. Through the labours of Mr. E. H. Man and the publications of Sir Richard Temple and Mr. M. V. Portman, a good deal was known concerning the general life of the people, their language, and other subjects, more particularly those of the southern tribes of the Great Andaman. Owing to recent developments in the studies of comparative sociology and religion, it was desirable that Mr. Man's observation should be confirmed and extended.

When the Board of Anthropological Studies in Cambridge was entrusted with the selection of the first Anthony Wilkin student, it had no hesitation in appointing Mr. A. R. Brown, of Trinity College, to undertake this important investigation. He started for the Andamans at the end of August, 1906, and spent two dry seasons of six months each at his field work in the jungles of the Andaman Islands. Mr. Brown was able to confirm a great deal of what Mr. Man had written concerning the southern tribes and to supplement this by a thorough study of the northern tribes of the Great Andaman.

Measurements on the living subjects prove the Andamanese to be a very homogeneous race, with little variation and a strongly marked racial type. In

their social structure and magical and religious beliefs they are the most primitive people who have yet been systematically studied. The Australians, so often spoken of as very primitive people, have well-developed totemic and local organisations, a classificatory system of kinship names, and elaborate systems of myths and magical beliefs. The Andamanese have no system of clans, but live in small hordes having little cohesion. Their system of kinship terms appears to be antecedent to the classificatory system. Their myths and magical beliefs are equally simple and undeveloped.

The Little Andamans are still left for future investigation, although Mr. Brown spent three and a half months with these wild islanders. As, however, there was no interpreter, the amount of progress which he made in learning their language was insufficient to enable him to pursue the investigation of their sociology and religion, but he has recorded their material culture. A. C. HADDON.

NOTES.

THE third annual general meeting of the British Science Guild will be held at the Mansion House to-morrow, January 22, at 4 p.m., under the presidency of the Lord Mayor. Mr. Haldane, president of the Guild, will address the meeting, and will be supported by Sir W. Ramsay, K.C.B., F.R.S., Sir F. Pollock, Bart., Sir Aston Webb, R.A., Sir Oliver Lodge, F.R.S., Sir Boverton Redwood, Dr. Bovey, and other speakers.

WE see with deep regret the announcement that Dr. Francis Elgar, F.R.S., whose scientific and practical work in naval architecture is of world-wide renown, died suddenly on January 17 at sixty-three years of age.

THE British Association will meet in Winnipeg from August 25 to September 1 of this year. The president-elect is Sir J. J. Thomson, F.R.S.; and the following sectional presidents have just accepted office:—A (Mathematical and Physical Science), Prof. E. Rutherford, F.R.S.; B (Chemistry), Prof. H. E. Armstrong, F.R.S.; C (Geology), Dr. A. Smith Woodward, F.R.S.; D (Zoology), Dr. A. E. Shipley, F.R.S.; E (Geography), Sir Duncan A. Johnston, K.C.M.G.; F (Economic Science and Statistics), Prof. S. J. Chapman; G (Engineering), Sir William H. White, K.C.B., F.R.S.; H (Anthropology), Prof. J. L. Myres; I (Physiology), Prof. E. H. Starling, F.R.S.; K (Botany), Lieut.-Colonel D. Prain, F.R.S.; L (Educational Science), Dr. H. B. Gray; and subsection, Agriculture, Major P. G. Craigie (chairman). A handbook of preliminary information, drawn up by the local executive committee, may be obtained from the office of the British Association, Burlington House, London, W., or will be sent to applicants enclosing 2½*d*. for postage.

A SUM of 20,000*l*. has been placed in the hands of the trustees of the medical school of the London Hospital to be invested to the best advantage, and the income from it to be expended in the advancement of medical research and the promotion of higher education in medicine. The administrators are the chairman, Mr. Sydney Holland, and two members of the acting staff of the hospital. It has been settled that the money is to be spent on increasing the facilities for research, and not for the routine teaching of candidates for examination. The benefits derived from the gift will not be confined to those students educated at the London Hospital, but will be open to qualified medical men from any part of the British Empire who are willing to give up their time to advancing medical knowledge within the walls of the London Hospital or college. The donor of this munificent gift desires to remain anonymous, in the hope that the fund which he has thus started will be added to by others, and that in time it may become of such magnitude as to be of great use to the present and to all future generations in the fight against, and the prevention of, disease.

AN interesting summary by Dr. H. R. Mill of the rainfall of the British Isles in 1908 appeared in the *Times* of January 16. The discussion is only a preliminary one, containing results of observations at ninety representative stations, and comparisons with the average of the last thirty years. A complete discussion of the data will appear later in "British Rainfall," but the author remarks, "the laborious re-computation from all the *data* ultimately available rarely shows the preliminary estimates to be much in error, though, of course, greater detail becomes possible." The production of the present summary in so short a time reflects great credit on the promptitude of the voluntary observers and on the staff of the British Rainfall Organisation. The figures show that the year was technically dry; the following are the percentages of the average for the general rainfall:—England, S., 86; Wales, 95; England, N., 91; Scoland, 98; Ireland, 101; British Isles, 93. The monthly values are, of course, much more variable than the annual; the author summarises them as follows:—"The collective rainfall of the country was above the average from March to the end of September. The dry October brought it back to the average, the dry November greatly reduced it, but a really wet December would have made it up in the end; and even with the moderately dry December the final deficiency, as has been shown, was not very great." June was very dry in England, but less so in other parts. The rainfall for London (Camden Square) was 23·67 inches, an inch and a half below the thirty years' average; but, the author remarks, London is a large place; the general average of the district ranges from about 23 inches in the low-lying parts near the river to at least 27 inches on the encircling girdle of hills.

M. ANTONY POINCARÉ has been elected president, and MM. Eiffel and Maillet vice-presidents, of the French Meteorological Society.

DR. SVEN HEDIN arrived at Stockholm on January 17, and had an audience of the King of Sweden, who presented him with the Grand Cross of the Polar Star. He will give an account of his recent expedition in Tibet at a special meeting of the Royal Geographical Society to be held in the Queen's Hall on February 8.

IT is announced in the *Chemist and Druggist* that Baron Bessières has left a legacy of 3200*l*. to the Pasteur Institute, Paris, to be employed in scientific researches in accordance with special instructions he has left with his executor.

THE seventieth birthday of Prof. G. Lunge will be celebrated on September 15, and a local committee has undertaken to arrange a suitable commemoration of the occasion. Chemists who desire to be associated with this festival should communicate with Dr. E. Berl, Zürich IV, Sonneggstrasse 84.

THE council of the Institution of Civil Engineers, after consideration of the papers on Indian engineering subjects published in the Proceedings for the past session, has awarded the "Indian premium" of the institution for 1908, of the value of 33*l*., to Mr. F. P. Anderson, for his paper on river control by wire net-work.

Prof. E. A. Minchin has left England for three months, accompanied by his assistant, Dr. Woodcock, on a visit to the zoological station at Rovigno, in order to carry on researches on the development of the trypanosome of the little owl (*Athene noctua*). All communications should be addressed to him at the Zoologische Station, Rovigno (Istria), Austria.

The Geological Society of London will this year award its medals and funds as follows:—Wollaston medal, Mr. Horace B. Woodward, F.R.S.; Murchison medal, Prof. Grenville A. J. Cole; Lyell medal, Prof. Percy F. Kendall; Bigsby medal, Dr. John Smith Flett; Prestwich medal, Lady Evans; Wollaston fund, Mr. Arthur J. C. Molyneux; Murchison fund, Mr. James V. Elsden; Lyell fund, Mr. R. G. Carruthers and Mr. Herbert Brantwood Muff.

During the past few days the following earthquake shocks have been reported:—*January* 13, *Rome.*—Earthquake shocks at 1.45 a.m. reported over northern Italy. Two distinct shocks with a few seconds' interval. *Vienna.*—Slight earthquake shocks at many points in the southern part of Austria, extending from Serajevo to Trieste. *January* 15, *Cape Town.*—Several shocks of earthquake have been felt recently in various parts of South Africa. One was felt at Johannesburg on this date.

Prof. Ricco, director of the Catania Observatory, who has just returned from Calabria, has stated to a correspondent of the *Times* that the quay and the houses at Reggio which stood near the landing quay of the ferry-boat have sunk considerably as a result of the recent earthquake; the point of the new jetty was actually under water. The sea wave, he says, reached a height of 11 feet at Villa San Giovanni, 13 feet at Pellaro, and rather more at Lazzaro; at Catania it was nearly 7 feet high, and at Messina 6½ feet, though it did more damage at Messina than elsewhere.

The death is reported of Prof. G. W. Hough, professor of astronomy at the North-Western University, Evanston, Illinois. Prof. Hough was born in New York State in 1836. After holding a subordinate post at the Cincinnati Observatory, he was appointed in 1860 director of the Dudley Observatory, Albany. In 1879 he became director of the Dearborn Observatory, Chicago, and professor of astronomy at Chicago University. He was appointed to his chair at Evanston in 1887. He published many reports embodying his discoveries, which were particularly concerned with double stars and with the planet Jupiter, and invented several instruments for use in astronomical and meteorological investigations.

The late Prof. Tait contributed to Nature between the years 1887 and 1893 a valuable series of papers on the physics of golf. It is interesting to note that these scientific articles are becoming a kind of classic, from which writers on the game quote with assurance. In *Golf Illustrated* for January 1, a contributor, by means of a searching analysis of Prof. Tait's writings, shows how mythical must be the story, so familiar on all golf links, that the redoubtable F. G. Tait in 1893 disproved his father's supposed dictum by driving a golf ball further than had been declared from mathematical calculation to be possible. So early as 1891 (see vol. xliv. of Nature) Prof. Tait had begun to see the explanation of the prolonged flight of a golf ball, and he was the last man to dogmatise on a scientific problem which still demanded a complete solution. It is said that he never denied the mythical tale; but was the question ever distinctly put to him? Moreover, it should be remembered that Prof. Tait enjoyed a good story to the full. No doubt the genial banter between father and son when the historic drive was made goes far to explain the germ of the myth.

The British Museum was opened on January 15, 1759, and therefore completed a century and a half of existence on Friday last. An interesting article in the *Times* of January 14 describes the origin and work of this great national institution. It is of particular interest to recall that Sir Hans Sloane, who was Newton's successor as president of the Royal Society, was chiefly responsible for the foundation of the museum, and that the main lines of its present constitution are laid down in his will. He made vast collections of specimens relating to natural history and antiquities; and the Act of Parliament of 1753, to which the museum owes its formation, states that one of the objects is "the purchase of the museum or collection of Sir Hans Sloane." The first directing officer of the museum, styled the principal librarian, was a man of science—Dr. Godwin Knight—known for his improvements of the mariner's compass. Until 1865 the chief accessions were specimens relating to classical antiquities, but upon the death of Mr. Henry Christy in that year, the museum accepted his ethnographical and prehistoric collections. In 1880 the natural history collections were removed to the new building provided for them at South Kensington, and it is becoming evident that further separation of the museum and the library must be contemplated. Upon this point the Times remarks:—"In the future the inevitable and constant growth of the library will call for additional space, and the ultimate separation of the national museum and the national library will undoubtedly come. Such a division is unquestionably more natural than the present state of things, which we accept because it has been of slow and unnoticed growth. The separation of the natural history collections may be described as beneficial to both sides of the museum, and may well serve as a precedent for the Government in the future, whenever the question may arise."

President Roosevelt has signed, says *Science*, a proclamation setting aside and naming the Ocala National Forest in Marion County, in eastern Florida, the first created east of the Mississippi River, and another proclamation creating the Dakota National Forest in Billings County, North Dakota. The two proclamations add two more States to the list of those wherein land will be put under scientific forest administration. There are now nineteen States, and Alaska, having national forests. Before the creation of the Ocala, in Florida, the two forests in Arkansas, the Ozark and the Arkansas, were the easternmost national forests. Practically all the other national forests are in the Rocky Mountain and the Pacific coast States. The Florida forest has an area of 201,480 acres, of which about one-fourth has been taken up under various land laws. It covers a plateau between the St. John's and Ochlawaha rivers, and at no point is an elevation exceeding 150 feet above sea-level obtained. The new Dakota national forest consists of 14,080 acres in the Bad Lands region. Its creation is important, for it means that an experimental field for forest planting has been secured in North Dakota, the least forested State in the Union, having only 1 per cent. of tree growth. The Forest Service expects to establish forest nurseries with the hope that in time to come the area may be re-forested by artificial means.

The annual general meeting of the Institute of Metals was held on January 19, when a paper on the relation between science and practice, and its bearing on the utility

of the Institute of Metals, was read by Sir Gerard Muntz, Bart. In this paper attention was directed to the fact that among members of the institute are to be found manufacturers, men of science, and engineers. In some cases the three grades are enrolled in one individual, but generally it will be from the harmonious correlation of the three grades that the benefits of the institute will accrue. After summarising the demands made upon the time and ability of the manufacturer, and pointing out that often cause and effect are noticed and taken advantage of in practice, but the reason why never discovered, and so it happens that the road thus shown is not explored, Sir Gerard Muntz dealt with the work of the man of science. Given, he said, results, cause and effect the man of science, if he persistently devotes himself to the task which is offered him, will probably eventually arrive at the why and wherefore of the matter. The man of science, he continued, has the necessary time; his vocation, as a rule, is embowered "in that cloistered seclusion which allows of consecutive thought and reasoning out of obscure and difficult subjects." No doubt a worthy tribute to the man of science on Sir Gerard Muntz's part, but it would have been more convincing had he made it clearer how the man of science he had in mind gains his livelihood. Referring to laboratory work, Sir Gerard Muntz said that without it nothing can be done; but, he went on, it is not sufficient for the man of science to demonstrate in the laboratory. Science must be reduced to practical form for everyday use before it can be made serviceable in manufacture. The practical worker has to depend on the man of science, and needs guidance in not too elaborate a form.

SYSTEMATIC ornithologists will welcome a list of new generic names proposed for birds during the years 1901 to 1905 inclusive, together with records of a number of older names not to be found in the "Index Generum Avium." The list has been compiled by Mr. C. W. Richmond, of the U.S. National Museum, and is published as No. 1656 of the Proceedings of that institution. The additions to the "Index Generum" are about 350 in number, but a certain proportion of these rank as *nomina nuda*.

A PAPER by Dr. E. D. Van Oort on the birds of the Netherlands, published in vol. xxx., Nos. 2 and 3, of Notes from the Leyden Museum, is illustrated by an exquisite photographic plate of two male barn-owls killed in Holland remarkable for their pure white breasts, totally devoid of black spots. In one the feathers of the disk are likewise nearly pure white, while in the other those on the lower border of the same are tipped with orange-buff and blackish-brown.

THE Journal of the Royal Society of Arts for December 25, 1908, contains the report of a lecture on the birds of India, delivered before the Indian section of the society by Mr. Douglas Dewar. After referring to the fact that India does possess song-birds, and mentioning the fearlessness and numerical abundance of Indian birds and the charm of birds in general, the lecturer proceeded to discuss the scientific study of birds, more especially in connection with natural selection.

IN the twenty-second annual report of the Liverpool Marine Biology Committee, Prof. Herdman laments the decease of two original members of the committee (Messrs. R. D. Darbishire and A. Leicester), as well as of other supporters of the Marine Biological Station at Port Erin. He further deplores the lack of earnest and well-to-do amateur naturalists, who formed the main support of that institution twenty years ago, and pleads the urgency of additional financial assistance if the work and publications (which yearly become more expensive) are to be carried on as heretofore. In response to a desire expressed by certain foreign visitors, Prof. Herdman has included in the report a detailed description, with plans, of the hatchery and hatching-boxes. The work of the institution has been carried on successfully during the year, although the problem of hatching and rearing lobsters has not been solved.

NO. 2 of the fourth volume of the Journal of the South African Ornithologists' Union contains the report of the committee for bird-migration for the years 1906 and 1907. Although a very large number of post-cards was circulated, the replies received were disappointingly small, not one out of 100 schoolmasters to whom cards were sent answering the appeal. Six species were entered in the schedule, namely, the swallow, bee-eater, lesser kestrel, greenshank, stork, and white-winged pratincole, and reports on the arrival and departure of these and other species were received from fifteen stations, ranging from Cape Colony to the Orange River Colony and Transvaal. The dates of the arrival of the swallow range from August 28 (Amersfoort, Rolfontein, 1906) to December 6 (Bethulie, 1907); the stork first appeared during 1907 on September 20, but the bulk of these birds seem to have come between November 9 and 24, while greenshanks were seen at three stations in the first half of October. The committee has sent out another series of circulars and cards, to which it may be hoped a larger proportion of replies will be received.

ANOTHER issue (No. 1652) of the Proceedings of the U.S. National Museum is devoted to copepod crustaceans parasitic on fishes from the Pacific coast of North America, with descriptions of several new genera and many new species. The author, Mr. C. B. Wilson, had the opportunity of working at a very extensive collection, which yielded very interesting results. Although the number of new species may appear relatively large, it is stated that a great difference between the Atlantic and Pacific representatives of these parasites is only what was to be expected, and but little was previously known of the latter. "The novelty of the characters of these new forms is of much less importance than the close relationship which they show between species inhabiting widely remote localities. . . . There are close correspondences between the Atlantic and Pacific copepods similar to those found in other groups of animals, particularly, perhaps, in the fishes which serve as hosts for these parasites."

THE first part of vol. iv. (zoology) of the report on the scientific results of the voyage of the *Scotia* during the years 1902–4, under the leadership of Dr. W. S. Bruce, has been received from the Scottish Oceanographical Laboratory, Edinburgh. From the start of the Scottish National Antarctic Expedition to its finish a daily record was kept of the observations of the naturalists both on board the ship and at the summer station. A field notebook, or naturalists' diary, of the expedition was thus secured, and this record is reproduced with no material alterations in the work just published. The interest and value of this zoological log is increased by many very striking pictures of oceanic and Antarctic life and scenes, the thirty-three plates including no fewer than a hundred illustrations from photographs. We propose to defer further notice of the work until other parts of the fourth volume of the report of the expedition have reached us.

THE editorial of the *Indian Forester* (December, 1908) is devoted to a well-merited eulogy of the services rendered to the Government of India by Mr. S. Eardley-Wilmot, the late Inspector-General of Forests. During the six years that he has occupied that post steps have been taken towards the better training and higher qualification of the staff, improved conditions of service, and the inauguration of the research institute at Dehra Dun; further, public opinion has been moved to recognise the value of the forests and to appreciate the work of the forest officers.

IN the Journal of the Quekett Microscopical Club (November, 1908) there is published an account of an investigation, by Mr. A. E. Hilton, into the streaming movements of plasmodia of the Mycetozoa. It is noted that the movements consist of rhythmic alternating currents that reverse on an average about every ninety seconds, and it was found possible to superimpose on the normal currents special movements induced by tapping lightly on a cover-glass placed on the specimen. Thus it is argued that pressure and suction or pulsations in the plasmodium are the cause of the currents, and it is suggested that such pulsations are probably indications of respiration proceeding in the organism.

THE subject of plant fasciations is treated by Miss A. A. Knox in Publication No. 98 of the Carnegie Institution of Washington. Fasciation is applied to stems that deviate from the normal circular shape, becoming more or less flattened, and that often show repeated branching. The plants investigated were *Œnothera biennis*, *Œnothera cruciata*, and other species of the genus. They produce rosettes of closely compacted leaves in the first year, and throw up flowering shoots later. They may either fasciate as rosettes, producing lopsidedness of stem and leaves, or subsequently, when the elongated stems become flattened or branch. Four different methods of forming fasciations are illustrated, but in each case development proceeds from a special meristem. In all cases fasciation is attributed to injuries inflicted by insects, and the author differs from de Vries in considering that the tendency to fasciation is not a heritable factor.

THE third and seventh volumes of the publication *Recueil de l'Institut Botanique Léo Errera*, Brussels—to give the title as modified on the last volume—have recently been issued. This publication originated in connection with the purpose of bringing together the papers emanating from Prof. Errera's laboratory. The third volume, containing contributions by several workers that were published in various journals during the years 1885 to 1900, indicates the wide scope of the research prosecuted there. Several papers by Dr. E. Laurent, notably the account of a study of the organisms giving rise to leguminous nodules, deal with the action of soil and fermentation bacteria. Cultures of the Mucedineæ are described by Mr. A. de Wèvre, the effect of external factors on karyokinesis is discussed by Dr. E. de Wildeman, and the morphological articles by Dr. J. Massart include a valuable thesis on recapitulation and innovation in plant embryology.

To the *Reliquary* for January Mr. J. L. Cowan contributes an interesting paper on aboriginal American industries. The chief and earliest of these is basketry, which was found in an advanced stage when Friar Marcos de Niza visited the south-western States in 1539. The designs are not accidental, nor do they represent the artistic conception of the worker. Each has its traditional significance—the cobweb pattern being connected with offerings to the spider deity, the deer-hunt with gods of the chase, and so on. Even a break in the design marks a place where evil spirits can find exit, instead of being confined to injure the owner. In the same way each colour has its own significance, red being the most sacred, as typifying the life of man. The transition from basketry to pottery, the basket being covered with clay to save it from injury by fire, can here be clearly traced. Pottery still maintains its ancient perfection only among the Hopi and Zuni communities, the former being specially noted for grace of design, artistic decoration, and faultless workmanship. The latest industry is that of blanket weaving. The arts of plaiting and weaving were known to the natives before the arrival of the European, but it is only since the introduction of sheep and goats that the craft of blanket weaving has been developed, with the result that the Navajos now admittedly make the finest specimens in the world.

MISS E. H. HALL has shown some courage in selecting as the subject for a doctorate dissertation at Bryn Mawr College "The Decorative Art of Crete in the Bronze Age," while Dr. A. J. Evans is still engaged at Knossos, and other promising sites in the island still remain unexcavated. This art series, extending over some two thousand years, begins with simple linear geometric ornament, notably with the zigzag motive. This develops into curvilinear designs, among which are motives resembling natural objects which gratify the primitive instinct for imitative art. Later on these exhibit increasing realism; but the non-imitative ornament is even more typical. By the Middle Minoan III. period this is superseded by pure naturalistic design, due to a local school trained under Egyptian influence. In the great palace-building age at Knossos and Phaistos conventional flower designs replace, in part, naturalistic motives. Lastly, we reach the stage of debased forms of naturalistic motives unintelligently copied, indicating not only lack of artistic originality, but the approach of a purely geometric style. Miss Hall's classification and analysis of the evolution of this school of art will probably not meet with general acceptance in all its interpretations, and her conclusions are always liable to be upset by new discoveries, but as it is accompanied by good sketches of typical examples it will be useful to students of this chapter in art history.

UNDER the title "The Diet of the Hindu," we published in November last (p. 42) a descriptive notice of a memoir by Captain D. McCay, in which he showed, in a systematic manner, and after thorough investigation, that a vegetarian diet has a deleterious effect on the metabolism and efficiency of the inhabitants of Bengal. We have received from Mr. Bernard Houghton, of Sagaing, Burma, a letter in reference to this article in which he points out that the Bengalis live in a damp, hot climate, that dhall bulks largely in their food, and that this diet is rich in purine substances. He is inclined to attribute part, at any rate, of their malnutrition to these circumstances. He states that the Burmese, who are rice-eaters, are in the hospital returns free from the diseases Captain McCay alludes to, and he believes that the same is true of wheat-eating Punjabis. In conclusion, he asks whether there is any evidence that these diseases are prevalent amongst the rice-eating Chinese and Japanese peasantry. In reference to these remarks, our reviewer, before whom we laid Mr. Houghton's letter, replies that he did not deal with the inhabitants of the Punjab and of Burma because he is not aware that similar experimental and statistical evidence is available on the metabolism of these people. If there are any differences in the general metabolism of the two classes of vegetarians referred to, they may be due to variation in climatic influences or to the amount of purine substances in the food, but positive statements cannot be made until

comparative data and statistics are produced. In reference to Mr. Houghton's last question, attention may be directed to the prevalence of the disease called beri-beri among the rice-eating nations, and that diet is an important factor was very strikingly seen at the siege of Port Arthur. At that date the Japanese Navy had abandoned their rice diet, whereas the Army had not, otherwise the two services lived under the same conditions; beri-beri still continued to decimate the soldiers, but among the sailors it was practically stamped out.

THE Meteorological Office has sent us the monthly meteorological charts (1) of the North Atlantic and Mediterranean, and (2) of the Indian Ocean and Red Sea, for the present month. In addition to the usual statistical information referring to winds, ocean currents, &c., prepared for the month in question from various publications of the hydrographic and meteorological offices in this country and abroad, all available space, both on the face and back of the charts, is utilised by data of much importance to seamen. A cablegram from Canada, dated December 12, 1908, reported heavy, close-packed ice at Quebec and L'Islet. On the back of the Atlantic chart is reprinted a very interesting memorandum on observations of waves and swell, drawn up by the late Sir G. G. Stokes while he was a member of the Meteorological Council. With reference thereto, the remark is made that "We learn from Sir George Gabriel Stokes that the low swells of deep water, which have long periodic times, cause high rollers when they come into shallow water."

WE have received from Dr. J. R. Ashworth a copy of an analysis of the meteorological elements of Rochdale, from observations since 1878, reprinted from the Transactions of the Literary and Scientific Society of that place for 1908. The author has subjected the monthly means to harmonic analysis, and has computed six component curves for each element. This method discovers several interesting points relating to the climate of Rochdale, *e.g.* the fifth subperiod of the rainfall formula exhibits a remarkably large amplitude; the author points out that "its maximum occurs on December 29 and every succeeding 73 days." A comparison with the rainfall at other stations shows, *e.g.*, that at Stonyhurst an equally large value for the 73-day period is exhibited, while at Oxford and Cambridge this subperiod is insignificant. This method is, generally speaking, too laborious for ordinary observers, but Dr. Ashworth's investigation will be of considerable use to students to whom the advantages of exhibiting results in the most concise form and the best means of calculating the constants may be unknown. Perhaps the greatest living advocate of the method is Prof. J. Hann; students will find much valuable information on the subject and on the meaning of the various parts of the formula in his papers in *Himmel und Erde*, vol. vi., parts viii. and ix., and Quarterly Journal of the Royal Meteorological Society, vol. xxv., pp. 40–65 (translation by Dr. R. H. Scott).

VOL. xl. of the Transactions and Proceedings of the New Zealand Institute, issued in 1908, contains several interesting contributions. Mr. R. Speight (p. 16), in a paper on terrace-development of Canterbury rivers, properly emphasises the importance of considering the varying amount of waste material supplied to the streams in successive epochs. Mr. A. M. Finlayson describes the interesting veins of scheelite and quartz that are now mined in the goldfields of Otago, the price of the dressed ore having risen in fifteen years from 20*l.* to 160*l.* per ton. Dr. P. Marshall shows that the so-called gabbro of Dun Mountain consists of grossularite and a pyroxene or an amphibole, and he makes the interesting suggestion that this rock probably results from the digestion of an adjacent limestone in the peridotite magma which provides the well-known dunite. Botany is represented by nine papers, including Mr. D. Petrie's account of a visit to Mt. Hector, 5106 feet in height, in which the changes in the flora, and even in the characters of individual species, at successive elevations are discussed. Mr. H. Guthrie-Smith, in "The Grasses of Tutira," describes the struggle between alien grasses and the returning indigenous species over farm lands watched by him for twenty-five years. The land has already become "sick" of the alien species, and, as its fertility lessens, the hardier native species tend to resume possession, and thus to redress "the balance of nature." There are twenty zoological papers, mollusca being largely dealt with; Mr. W. H. Webster contributes seven new species, which are figured. Strong pleas are put in for the protection of native birds, presumably with the exception of the kea, which Mr. G. R. Marriner again holds up to obloquy. This volume, including as it does 608 pages and thirty-four plates, is a monument to the activity of the local societies and of the central institute that unites them.

EVERYONE who is working at radio-activity at the present time feels the need of a standard of activity in terms of which all measurements of activity can be expressed. It was suggested three years ago by Prof. H. N. McCoy, of the University of Chicago, that the activity of one square centimetre of a layer of suitable thickness of uranium oxide, U_3O_8, would furnish an excellent standard. In the December (1908) numbers of the *American Journal of Science* and of *Le Radium* Prof. McCoy gives an account of the work he has done, in conjunction with Mr. G. C. Ashman, to show that such a layer has all the properties required in a standard. The oxide is easily prepared, and samples prepared from three different sources gave identical results. A layer of thickness such that 0·02 gram goes to the square centimetre gives the maximum activity due to the α rays. The radiation due to the β rays is small.

MESSRS. H. F. ANGUS AND CO., 83 Wigmore Street, Cavendish Square, have just issued a summary of catalogues of apparatus for testing and correcting vision, relative magnification, actual magnification, projection, prismatic work, angular and linear measure, and other scientific observations. Of particular interest is the announcement of a series of demonstrations on the manipulation of the microscope and its accessories, free to all who care to avail themselves of them. These demonstrations should be of real service in showing what can be accomplished by modern instruments and preparations.

THE "Science Year Book and Diary" for 1909 is now available. It is edited, as in former years, by Major B. F. S. Baden-Powell, and maintains the distinguishing characteristics to which attention has been directed in these columns on previous occasions. Among other additions in the present issue may be mentioned a table of the vegetable kingdom specially compiled by Dr. Rendle, of the British Museum. The frontispiece consists of an excellent portrait of Sir William Ramsay, K.C.B., F.R.S. The book is published by Messrs. King, Sell and Olding, Ltd., Chancery Lane, London, and its price is 5*s.* net.

MESSRS. MACMILLAN AND CO., LTD., have published a new edition of Mr. T. A. O'Donahue's "Colliery Surveying." The book was reviewed on its first publication in NATURE of March 11, 1897 (vol. lv., p. 438). It is only necessary to add that extensive revisions and additions have been made in the present issue.

OUR ASTRONOMICAL COLUMN.

Periodical Comets due to Return this Year.—In a letter to the *Observatory* (No. 405, January, p. 56) Mr. Lynn directs attention to the periodical comets which may be re-discovered during the current year.

Halley's comet cannot be reckoned among those of 1909, for its perihelion passage does not take place until next year, but it seems likely that it will be re-discovered, at least photographically, before the present year closes.

The only short-period comet likely to be re-observed is that generally known as Winnecke's, because he, after re-detecting it in 1858, proved its identity with the object discovered by Pons in 1819. The period is about $5\frac{1}{2}$ years, and it was re-observed in 1869, 1875, 1886, 1892, and 1898; on the latter occasion it passed perihelion on March 20, so it should become observable early this year. In 1880 and 1903 it was unfavourably situated, and was not seen.

The Changes in the Tail of Morehouse's Comet.—In No. 4297 of the *Astronomische Nachrichten* (p. 1, January 9) Prof. Max Wolf discusses the forms and motions which successively occurred in the tail of comet 1908*c*, as shown by measurements of photographs taken at the Heidelberg Observatory.

Prof. Wolf gives the results of his measures of pairs of photographs taken at definite intervals, and shows that the matter forming the tail appears to have been expelled in waves, these waves being shorter than the similar ones seen in Daniel's comet. The length of these waves appears to be approximately proportional to their distance from the nucleus, whilst their amplitude is still nearer proportional to their distance.

Examined in the stereoscope, these wave-forms take a screw-like appearance, the south-eastern edge of each condensation or cloud appearing to be nearer to the observer than the north-western edge. In general, the measures show that recognisable condensations travelled with a greater velocity as they receded further from the head.

The Magnetic Field in Sun-spots.—In No. 4, vol. xxviii., of the *Astrophysical Journal* Prof. Hale publishes a full discussion of the recent work which led him to recognise the existence of powerful magnetic fields in sun-spots.

As previously described in Nature (August 20, 1908, No. 2025, p. 368), these fields were demonstrated by the appearance of the Zeeman effect in connection with certain lines in the sun-spot spectrum. Subsequent work has amply confirmed the conclusions then arrived at, and one or two difficulties have been removed. One of these difficulties was that certain doublets did not appear as triplets even when the spot was as much as 60° from the centre of the sun; another was that the iron line at λ 6302·71 appeared as an asymmetrical triplet in the spot spectrum, and was accordingly classed as a doublet with an interfering line of some other element. Work on laboratory spectra, carried out by Dr. King, has, however, shown that these apparent anomalies occur in the terrestrial spectra, and are therefore real phenomena due to the magnetic field.

The Spectrum of Mars.—The occurrence of the *a* water-vapour band in the spectrum of Mars, previously reported briefly, is discussed at some length by Mr. Slipher in the December (1908) number of the *Astrophysical Journal* (vol. xxviii., No. 5, p. 397), and illustrated by reproductions of the convincing spectra obtained by the author at the Lowell Observatory.

Previous investigators of the question of water-vapour bands in the Martian spectra have been at a loss because, whilst visual observations were necessarily unconvincing, photographic observations of the most suitable region of the spectrum, the *a* band, were very difficult. Mr. Slipher used especially bathed plates, which gave good spectra of this region, and by taking a comparison spectrum of the moon on the same plate, with the altitudes of the planet and the moon approximately the same, he obtained indubitable evidence that water-vapour plays an important part in the planet's absorption.

The photographs reproduced show the reinforcement of the *a* band in the spectrum of the "low sun" as compared with the "high sun," and then show the strong reinforcement of this band in the spectrum of Mars as compared with that of the moon; whilst, on the photographs compared, the other lines and bands of the Martian spectrum are generally weaker than they are in the moon, the *a* band is, without any question, appreciably stronger.

More observations are necessary before the amount of water-vapour in the planet's atmosphere can be stated, but the results favour the existence of "snow caps" and a moderate temperature rather than "hoar-frost caps" and a low temperature for Mars.

A Brilliant Meteor.—Mr. P. Evans, of Kettering, reports that he observed a brilliant meteor at that place on January 11. The object appeared at 8h. 10m. p.m., its head being very bright, "like burning magnesium," and followed by a tail 10° or 15° long; Mr. Evans adds that the meteor was seen low down in the west, and travelling in a southerly direction.

Camelopardalis, Camelopardalus, or Camelopardus?—Prof. E. C. Pickering devotes Circular No. 146 of the Harvard College Observatory to a discussion of the proper spelling of the name of this constellation, named by Hevelius in 1690, in order that a uniform spelling may be rigidly adopted by astronomers when making references to it.

After consulting the classical, zoological, and astronomical authorities, he concludes that the correct spelling is Camelopardalis.

REPORT ON AFFORESTATION IN THE UNITED KINGDOM.

The second report (on afforestation) of the Royal Commission appointed to inquire into and to report on certain questions affecting coast erosion, the reclamation of tidal lands, and afforestation in the United Kingdom has just been published as a Blue-book (Cd. 4460, price 6*d*., Wyman and Sons, Ltd., 109 Fetter Lane, E.C.).

It will be remembered that in March, 1908, the terms of reference of the Royal Commission on Coast Erosion were extended so that the commission should inquire and report "Whether in connection with reclaimed lands or otherwise, it is desirable to make an experiment in afforestation as a means of increasing employment during periods of depression in the labour market, and if so by what authority and under what conditions such experiment should be conducted."

We propose to discuss the report later, and only give now the summary of the conclusions of the commissioners.

Summary of Principal Conclusions.

(1) The natural conditions of soil and climate in the United Kingdom are favourable to the production of high-class commercial timber such as is annually imported into the country in very great quantities.

(2) The afforestation of suitable lands in the United Kingdom, if undertaken on an adequate scale and in accordance with well-recognised scientific principles, should prove at present prices a sound and remunerative investment.

(3) In estimating the profits of sylviculture account must, moreover, be taken of two facts, the increasing consumption of timber per head of population all over the world, in spite of the introduction of alternative materials, and, further, the exploitation, waste, and destruction by fire of the virgin forests, especially those yielding the more important building timbers. Already a noticeable shortage of timber supply has resulted, as is evidenced by steadily rising prices and depreciating qualities in all markets. It seems impossible to escape from the conclusion that this tendency will be continued and accentuated, and that a steady and a very considerable rise in prices may be looked for throughout the present century. The security which afforestation offers for investment is therefore likely to be an improving one, with a corresponding increase in profits, but, to avoid all that is speculative, this prospect has been disregarded in framing our estimates.

(4) The amount of land suitable for afforestation, but not now under timber, in the United Kingdom may roughly

be put at a maximum of 9,000,000 acres. In determining this figure two considerations have been taken into account, besides elevation and physical suitability of soil. The first is that the value of the land is not in excess of a sum on which a fair return may be anticipated on the expenditure. This will naturally vary according to the productive capacity of the soil and the crop which it will carry. The second consideration is that the land could not be more profitably utilised in any other way.

(5) A forest of 9,000,000 acres, in which are represented the various series of age-classes, may be expected to yield 9,000,000 loads annually in perpetuity. The importation of foreign timber from temperate climates into the United Kingdom in the year 1907 exceeded 8,500,000 loads, or approximately the annual supply which could be expected from the afforestation of the above-mentioned area.

(6) The withdrawal of 9,000,000 acres from its present uses would cause some gradual curtailment of food supplies and displacement of labour. Land suitable for afforestation is mostly devoted to the production of mutton. Calculations on the basis of the present consumption show that at most 60,000 tons, or 4·8 per cent. of the total home production of meat, or 2·6 per cent. of the present national consumption, would be ultimately displaced. As to labour, the employment furnished by the present uses, mostly sheep farming, to which the land in question is devoted, may be taken to average one man to 1000 acres. This does not represent one-tenth of the permanent employment afforded by the maintenance of a similar area of land under forest.

(7) Systematic sylviculture aims at the production of a steady and continuous supply of marketable timber. To ensure the maintenance of these supplies the area should be divided for planting by the average number of years which the crop needs to mature; for example, if the life of the crop be taken as eighty years, the area to be afforested every year would, out of a total area of 9,000,000 acres, be 112,500 acres. But a more rapid system of planting may be adopted without seriously complicating the rotation, and further, some adaptation to the temporary fluctuations of the labour market is feasible.

(8) The distribution of this 9,000,000 acres of suitable land is somewhat irregular. By far the largest areas are to be met with in the west and north of England, and throughout similar regions in Scotland. Ireland and Wales also contain a relatively large amount of this type of land. In the south and east of England, on the other hand, the areas in the aggregate are less extensive. Great diversity exists in the size of these areas, some counties offering large contiguous stretches, while in others the areas are characterised by their discontinuous nature.

(9) The administration of national forest lands should be entrusted to special commissioners.

(10) In dealing with these lands, subdivision into distinct districts, with an executive and administrative subcentre, commends itself from various points of view. Thus local employment would be afforded, local subsidiary industries would be encouraged, public recreation grounds would be provided, and, in connection with the establishment of such forests, small holdings would undoubtedly be multiplied.

(11) Sylviculture in the United Kingdom is an enterprise which rarely appeals to the private landowner or capitalist. The prolonged time for which capital must be locked up before any return can be expected, the loss of rent and burden of rates over the whole period, and the absence of security for continuous care and management, act as deterrents. None of these objections applies to the State, the corporate life and resources of which lend themselves in an especial degree to an undertaking of this character. If the State plants, it will certainly reap, which the individual owner can rarely hope to do.

(12) If afforestation be promoted on a large scale the provision of suitable lands is the first step. For this purpose a general survey should be made, and the extent and distribution of such lands ascertained. As a rule, it will be found expedient for the State to purchase from time to time such areas as are destined for planting, but some progress may conceivably be made along the lines of profit-sharing, in which case the owner would forego the purchase price. Experience proves that, although much of the land required may be expected to be purchaseable by voluntary treaty, yet compulsory powers would be necessary to facilitate transactions where voluntary treaty had broken down. The principle laid down in the Small Holdings Act of 1907 for the acquisition of lands should govern these proceedings as to arbitration, restrictions, and safeguards. Where private owners can satisfy the Forest Commissioners that they are able and willing to afforest under their supervision and to their satisfaction, and give an undertaking to that effect, compulsory powers should not be enforced against such owners so long as that undertaking is fulfilled.

(13) The value of land falling within the definition of "suitability" may be taken, except in rare instances, to lie between *2l.* and *10l.* freehold value; but the average value of suitable lands, including the necessary buildings and other preliminary equipment, may be taken as *6l. 10s.* per acre, and the average cost of afforestation also at *6l. 10s.* per acre. If 150,000 acres be annually taken in hand, a sum of about *2,000,000l.* would be needed annually to finance the undertaking.

(14) Money expended in afforestation differs in kind from other calls on the national purse. It is a productive investment of capital. To provide this capital sum out of taxes would be an act of unprecedented generosity on the part of the present generation of taxpayers in favour of their posterity. No stronger justification for proceeding by loan than a reproductive outlay exists. The loan should be based on actuarial calculations showing initial cost, expenses of upkeep and management calculated at compound interest over the whole period, and the value of the property when fully matured. Such actuarial statements we have given, which show, for the full scheme, that, after allowing 3 per cent. compound interest on all the capital invested, the approximate equalised revenue would at the end of eighty years amount to *17,411,000l.* per annum, while the value of the property might be expected to be *562,075,000l.*, or *106,993,000l.* in excess of the sum involved in its creation. A smaller scheme, involving the afforestation of 6,000,000 acres (75,000 acres annually for eighty years), would show a profit of about *10,000,000l.* annually, or a capital value of *320,000,000l.*, being *60,944,000l.* in excess of the cost of production.

(15) Coming to ways and means by which a loan of this character may best be provided, a point of great importance to be borne in mind is that, although the period of rotation of a timber crop may be taken as eighty years, yet, after forty years, owing to the value of thinnings and the receipts of some short-period crops, the forest becomes practically self-supporting. Between the fortieth and eightieth years, the sales of timber will be sufficient to meet the annual charges, including the upkeep and the extension of the forest. After the eightieth year a large annual revenue will be derived. These considerations point to a free loan from the Treasury to the Forest Commissioners; the net deficit to be met would in the first year be *90,000l.* or *45,000l.*, according to the extent of the operation, and would reach its maximum in the fortieth year, amounting in that year to *3,131,250l.* or *1,565,625l.* After this period the deficit would be insignificant, while in the eighty-first year the revenue derived would be *17,411,000l.* or *10,000,000l.* respectively, representing about $3\frac{3}{4}$ per cent. on the total accumulated costs of the undertaking.

(16) On the question of labour and its relations to forestry, the conclusions to which the evidence before them leads your commissioners are that the operations involved in afforestation vary in the degree of requisite skill from little or none in rough road-making and surface draining to a considerable amount in the planting. Your commissioners wish to make it clear that they have in contemplation a scheme of national afforestation on economic lines. They have no hesitation in asserting that there are in the United Kingdom at any time, and especially in winter, thousands of men out of work for longer or shorter periods who are quite ready and able to perform the less skilled work without previous training, and with satisfactory results. There is a still larger class of unemployed who are capable of being trained to perform this or the

higher class of labour, and such men can, if desired, be recruited through labour colonies, distress committees, labour bureaux, or charitable agencies. There is, then, no need to accept inefficient labour with the object of affording occupation to the unemployed. The labour employed in the national forests should not fall below the ordinary standards, and should be remunerated at the ordinary rate of the district for similar labour. Subject to the requisite standard of efficiency being attained, preference should be given to those temporarily or permanently unemployed in the district, especially where evidence of such efficiency can be furnished by public or private agencies for the reclamation and training of the unemployed class.

(17) To establish afforestation on commercial lines does not, however, preclude its being used as an instrument of social regeneration. A broad view of economics cannot exclude from its cognisance the grave national charge which unemployment with all its concomitant results involves, to say nothing of the personal deterioration by which it is often accompanied. Sylviculture is not unsuitable for building up the moral and physical fibre of even the most depressed of the unemployed classes, and its agency may well be invoked for this purpose, and advantage taken of its healthy and wholesome influences, provided that any additional expense incurred by the employment of less efficient labour be defrayed from a separate account.

(18) In estimating the amount of employment furnished by afforestation, it is well to distinguish between the temporary labour involved in the creation of the forest and the permanent labour needed for its maintenance. Taking varying circumstances into consideration, it may be said that, on the average, it will take twelve men to afforest 100 acres in the planting season of four to five months, and that every 100 acres afforested will provide permanent employment for at least one man. If 150,000 acres be annually taken in hand, the labour of 18,000 men will be needed, and permanent employment will in due course be afforded to 1500 men, rising by an additional 1500 every year until the end of the rotation. The number permanently employed would then approach 100,000. The labour absorbed by felling and converting timber, to say nothing of subsidiary industries which spring up around a timber supply, has been considered too remote to warrant detailed estimation, but there is undoubtedly a large field of employment in this connection. It is important to remember that, on the basis of 1,000,000*l*. being annually spent on the operations of afforestation, apart from the cost of the land, employment would be afforded, directly and indirectly, to many more than 18,000 men. Indeed, the number employed may be roughly taken to be represented by about double that figure. For the incidental occupations, such as building, the making of implements, the provision of materials, &c., all involve the employment of additional labour.

(19) A special advantage of forestry in relation to labour is that it offers a new source of employment. The labour connected with timber and timber products imported into the country is performed abroad, and thousands of families are maintained on the produce of the labour associated with the timber industry. Another advantage bound up with the extension of sylviculture is that the market for its produce is so great that it is inconceivable that it could seriously interfere with the output from private woodlands, and no difficulty of competition between the State and individuals need be apprehended.

(20) The acquisition of grazing areas, private or common, for sylviculture might necessitate a modification of the existing agricultural system on certain farms. It is unreasonable to suppose that the remaining lowland areas on such farms could not, in many cases, either be adapted to other forms of agriculture or be profitably utilised for small holdings. Further, the conversion of comparatively unprofitable lands into forests enhances the productiveness of the adjacent areas, and should materially assist the small holdings movement. It has also the advantage of furnishing winter employment to small holders.

SCIENCE MASTERS IN CONFERENCE.

THE Association of Public School Science Masters held its ninth annual meeting at the Merchant Taylors' School on January 12, under the presidency of Sir Clifford Allbutt, K.C.B., F.R.S., who delivered an address entitled "The Function of Science in Education."

"If," he said, "our fathers looked out from a darker world upon a narrower dawn, it was upon an intenser light and a nearer vision than ours. We know better where we are, it is true; we can see more—we certainly run after more; but are we pressing as keenly forward on the line of promise? We are cutting and paving the road better for the throng upon the route; but the engineer who maps and makes the road may be too busy to regard the forerunners who, heedless of moss and rock, are crying to the multitude to cast aside every weight and race forwards to the light. Still, both prophet and engineer are needful to us, and it is a straight and business-like inquiry for men of science to ask themselves how far they are engineers, how far prophets.

"The home and the school should develop the service of the child, the imagination of the child, his intellect, and his ethics. Morals cannot yet be explained to him scientifically; the help of science to ethics will be recognised later. If scientific training does not generate the passion for righteousness, by its ordinances these aspirations are directed and fortified. Until the conceptions of modern science had permeated us, we had no full sense of the unity of society nor of our duty to our neighbour. As now the survival of the fittest has become an emulation, not of individuals, but of social groups, it is the most coherent groups which will govern the earth. In science may be discovered the sanctions of simplicity, sincerity, and brotherhood to chasten a luxurious age, such as in former times literature alone, even an Augustan literature, failed to regenerate.

"What do we mean by science? We do not contemplate experimental science only, we include the pristine idea of all orderly knowledge, of analysis of concepts for the construction of systems of affirmative propositions. There is no branch of education, or of the business of life for which it is to fit us, which science is not busily re-handling, remodelling, and re-interpreting. This is not to say that the methods you and I represent are to become sole masters of mankind. Action may be sicklied o'er by too much thought, by too much analysis, and herein is engendered that distrust—reasonable and unreasonable—which the humanist has always felt of the man of science. The humanist winces to see the flower of literature stiffened into a diagram. My point of view demands the pursuit of what is called 'classical' culture, not as in itself education, but as a constituent of education.

"The British boy, generically speaking, is a very matter-of-fact little person; very serious, very curious, and very handy. It is from his great example *man* that he may learn flippancy, satiety, mental inertia. In our educational methods do we foster the precious seriousness of the boy? Do we feed his curiosity, or do we snub and disgust it, so that when he leaves school all or much of his natural ardour for knowledge is blighted? All schoolmasters must learn, what the science-master can teach them, that, if by his own hands the boy can contrive no great art, yet it is immediately by promoting the activity and precision of his nervomuscular system that nature is building up, not his practical brain only, but also much of the hive of his mind—not to mention the congruities of bodily sanity. The boy will tolerate drudgery if his seriousness is not fatigued, and if his eyes are lifted continually over the dry intermediate task to realise what he is to see at the end of the hard high road. He must be led, not only to do the right things, but also to enjoy them. (By the way, is there a public-school playing-field in England which has been accurately surveyed and mapped by the boys?) The boy's curiosity might be better cherished by a more comprehensive literary outlook. By the new history, the new archæology, the new geography, the 'classics' are indeed becoming more of a living subject; we are bold enough to claim that it is by science that these changes have been wrought, and that, with-

out leaving other studies undone, natural science taught by masters who retain the keen curiosity of the boy, who are still as serious as the boy, and who can beat him in handiness and research, is an integral part of education. It is eminently fitted to cherish his seriousness, to develop his curiosity into research, and to multiply his formative dexterities.

"I admit a little bias against abstract science for boys. Some mathematics must enter into the curriculum; but my impression is that most schoolboys are almost as incapable of abstraction as terriers. Some older boys can get no inconsiderable grip on universals; but it is a topsy-turvy education which begins with universals and ends with a few particulars. For most boys natural history and mechanics may prove more congenial than chemistry.

"Science is not a hobby, nor even a modern system of utilitarian ingenuity; it is a way of observing and interpreting everything, including religion. In later life, most of us have to concentrate upon specific studies or crafts; but while I plead for even more differentiation for the various boy than at present he has, I protest that to box off 'science' artificially on a 'modern' or any other 'side' is to perpetuate an unnatural schism. An education which is not modern is an anachronism. I do not desire to see headmasters more specifically scientific than linguistic; but he who is to mould a school should inspire it as a whole, and be in full and understanding sympathy with every part and function of it. If he only knows so much of science as to misunderstand it, or just to tolerate it, the educational mill will continue to throw out, to the right and to the left, batches of half-educated men."

Mr. L. Cumming, in moving a vote of thanks, took the opportunity to point out that their boys had to pass examinations, and that examiners set questions on "abstract science." Dr. Garnett, in seconding the vote, directed attention to the fact that some boys can learn from reading, some from tactile perceptions. We should be ready to gain access to the mental citadel by the particular gate which happened to be open. In his reply, the president said that there will be a great saving of time when the scientific spirit gets possession of the school and compels coordination in teaching. The universities were partly to blame for the perpetuation of the segregation of schoolboys into classical, modern, and other sides, as their prizes are on the side of Greek and Latin.

Mr. M. D. Hill gave an account of the anthropometric work which has been carried on for fifteen months at Eton. Anthropometry includes psychological and physiological characters as well as morphological, tracing correlations between characters while examining the effect of environment. Psychologists, ethnologists, and statesmen require data which must be obtained from anthropometry. Already the examination of 500,000 children in Scotland as to colour of hair and eyes has solved problems of race-migration. Their work at Eton was connected with medical inspection. Instructions for practical work could be found in the report of the committee of Section H of the British Association, 1908. Mr. Gray, as secretary to this committee, expressed the hope that public schools would take up the inquiry so as to make it national in scope. We want an audit of national physique. Mr. Earl (Tonbridge) had found the value of such observations from the schoolmaster's point of view, as they make possible the detection of defects, and in his experience remedial treatment has resulted in the improvement of the physical tone and alertness of boys.

In the afternoon there was a discussion on the British Association report on the sequence of science studies in boys' schools. Mr. G. F. Daniell introduced the subject, saying that the inquiry had shown the existence of general agreement as to the subjects to be taught and as to their sequence, but that great diversity of opinion and practice exists in regard to methods. This diversity was approved; the teacher's liberty should be preserved and the influence of external examinations restricted. Mr. W. D. Eggar (Eton) spoke of the growth of geography as a school subject. This quite desirable growth had made the subject too wide for one teacher; he advocated putting physiography into the science course, and leaving commercial and historical aspects to be dealt with by other than "science" masters. Mr. R. G. Durrant (Marlborough) read a paper on teaching the nature of solution in schools, and advocated the introduction of the ionic theory as soon as the boys had some idea of atoms and molecules. Mr. G. H. Martin (Bradford) gave an account of his science course for boys on the *classical* side. He had found most successful results from geology, and he concluded that the only form of science suitable to such boys was one which, besides being of immediate application, furnishes the basis of an after-school hobby and permanently enlarges the mental outlook. A discussion followed, in which Sir Clifford Allbutt, Prof. Armstrong and others took part. A resolution protesting against the refusal of the General Medical Council to "recognise" public schools in their regulations for the registration of medical students was passed on the motion of Mr. C. I. Gardiner.

As in former years, the exhibition of apparatus formed an important and instructive feature of the meeting. Twenty-four members contributed useful and novel pieces of apparatus, often of much ingenuity, and occasionally of delightful simplicity. Several well-known firms of apparatus dealers and publishers sent displays which filled the great hall, and the whole display could not be exhausted in the four and a half hours allotted to its examination. We note a few of the objects of interest.

Dr. T. J. Baker showed a safe method of liberating hydrogen from water by action of potassium. A layer of naphtha is poured on the water, and a fragment of potassium is thrown in. The form of Hore's apparatus exhibited by Mr. D. J. P. Berridge derived interest from the fact that it was designed by a boy at Malvern. Mr. Berridge's still and water-bath (made by Fletcher, Russell and Co.) is of a serviceable pattern for school laboratories. Several teachers will thank Mr. Cooke for his method of burning magnesium in steam by plunging an ignited helix into a flask where water boils briskly. Mr. Cross exhibited "components" for building up "simple machines" and compounding them; being well made, they should have much educational utility. Electrical instruments such as can be built in school workshops—perhaps the best way of teaching electricity to many boys—were shown by Mr. L. Cumming. Quite a large and varied set of exhibits was contributed by Mr. Garbutt, including a nearly fool-proof apparatus for showing the volume composition of hydrogen chloride, and an ordinary Bunsen burner converted into a rose burner by drilling holes near the top of the tube and putting a small flat asbestos circle or dish on the top. Most of us have experienced trouble from burettes with broken taps; Mr. Hedley showed us how to repair them with ebonite taps, shaped by any carpenter. Mr. Martin's laboratory illustrations of geological phenomena helped to enforce the arguments of his paper. Mr. Ryley's evaporating crucible and Mr. Talbot's lantern are already well known. We liked Mr. Leyland Wilson's improved shelf for ovens, and his method of purifying sulphuretted hydrogen deserves trial. He passes the impure gas over calcium hydrate and moist sawdust, which absorb the sulphuretted hydrogen only. The latter can be liberated at any desired rate whenever required by passing a current of carbon dioxide over the calcium sulphydrate.

Among the trade exhibits we may mention the galvanometers and curved mirrors by Messrs. Philip Harris and Co., who have just issued an excellent catalogue. Messrs. Becker have attained the acme of simplicity in their burette stand, made in teak, at half-a-crown. We saw some useful clamps for chemical and optical apparatus at the stand of Messrs. Collins. Messrs. Reynolds and Branson have fitted a thoroughly satisfactory microscope attachment to the Stroud-Rendell lantern, and a blow-fly proboscis was shown with good definition and illumination. It is a pity that so few science-masters employ the lantern microscope for class purposes. Good design and accurate finish characterised the instruments for teaching mechanics which Mr. G. Cussons had on view. Experienced workers would not like to be without his "tripod and capstan" stands and clamps. We were reminded that we live in an age of luxury when we looked at Messrs. Griffin's electric furnaces; but the same firm caters for those who, from choice or necessity, seek to reduce expenditure on

apparatus. Their school microscope, with objective eyepiece, rack focussing stand with firm foot, is priced at 35s. We welcomed old and tried friends in the Becker's Sons' balances, and a new one in the Dobbs's dynamometer, which appeared among Messrs. Townson and Mercer's display. Mr. Thomas Wyatt exhibited the appropriately named Massey series of apparatus for practical mechanics, and some Haldane Gee instruments of better construction than those on the market in former days. The stills and ovens of Messrs. Brown and Son are well known to chemists; they should be well known to science masters.

We have not space to describe the extensive exhibit of books by Messrs. Arnold, G. Bell, Clive, Macmillan, Methuen, and the Cambridge and Oxford University Press.

Some of the amateur exhibitors were at too little pains to show their work effectively, and we would remind them of the necessity of making clear at once, by diagram or otherwise, the main point of their exhibits. If a plan of the exhibits could be added to the catalogue it would be helpful. The trade exhibits are of undoubted utility, especially to country workers, but it is to be hoped that the invaluable display of resourcefulness and ingenuity springing from our school laboratories will not be relegated to a subordinate position. The thanks of all who had the good fortune to see this successful exhibition are due to the hon. secretaries, Mr. D. J. P. Berridge and Mr. G. H. Martin, for their skilled cataloguing and organisation.

The president of the association next year will be Prof. H. E. Armstrong, F.R.S., who has given the society much help since its foundation.

G. F. Daniell.

VARIOUS INVERTEBRATES.[1]

The fourth volume of zoological reports on the *Discovery* collections is full of interest and fine workmanship. It well deserves its beautiful "get-up." Dr. H. F. Nierstrasz describes the single Solenogaster in the collection—naming it rather awkwardly *Proneomenia discoveryi*, sp. n., and takes a survey of the family Proneomeniidæ. Prof. G. H. Carpenter gives an account of a remarkable collembolon—*Gomphiocephalus hodgsoni*, g. et sp. n.—apparently an ancient connecting link between Poduridæ and Entomobryidæ. In contrast to these two cases of sparse material, we find Mr. W. M. Tattersall reporting on more than ten thousand schizopods, mostly referable, however, to one species. He and Mr. Holt have been able to add ten to the previous list of seven South Polar schizopods, and the present memoir as some interesting results as regards life-history and dist..bution. The collection includes no species of schizopod common to both polar regions, but all the genera save one, Antarctomysis, are represented in northern waters. The northern species are quite distinct from their southern allies.

Similarly Dr. R. N. Wolfenden notes that the Antarctic copepod fauna is distinct from that of Arctic seas, and that the species which are typical of the Antarctic and most numerous do not extend far into the southern Atlantic at least. The *Discovery*, like the *Gauss*, was fortunate in finding the interesting crinoid Promachocrinus, which was one of the prizes of the voyage of the *Challenger*. Prof. F. Jeffrey Bell deals with this re-discovered treasure, and with a number of interesting new forms; he also directs attention to the "bewildering" variability of several species, e.g. *Cycethra verrucosa*. His memoir has numerous illustrations of a certain dry humour, as when he notes that "even the most recent writers on echinoderms have not yet promulgated the doctrine that difference in size is a specific character, though I am not quite sure that in practice they do not sometimes act as though they had." It has been supposed that none of the Antarctic echinoderms has free-swimming larvæ, but Prof. E. W. MacBride and Mr. J. C. Simpson describe the plutei of a sea-urchin and an ophiuroid. They also found an unsuspected brood-pouch in *Cucumaria crocea*, a well-known holothurian.

Bell's *Antedon adriani* yielded two species of Myzostomum, which Dr. Rudolf Ritter von Stummer-Traunfels deals with. One is new, *M. antarcticum*, illustrating the common experience that every new species means another new species—of parasite; the other, *M. cysticolum*, has been previously recorded from Ross's Sea in the Antarctic, from off the east coast of Japan, and from the tropical West Atlantic—a remarkable distribution which finds its explanation in the antiquity of the myzostomid group and in the uniformity of deep-water conditions. The sipunculids are represented by some thirty specimens. These Mr. W. F. Lanchester describes under the title *Phascolosoma socius*, n. sp., and in so doing makes some interesting critical remarks on the relative value of the systematic specific characters in this group. Two new sea-anemones are described by Mr. J. A. Clubb, but the most interesting part of his report is the description of the sixteen "brood-pouches" of *Cribrina octoradiata* (Carlgren) from the Falkland Islands. Each pouch arises as an invagination of the three layers of the body-wall, retains its external pore, and usually contains two embryos. In reporting on the tetractinellid and monaxonellid sponges, Mr. R. Kirkpatrick describes twenty-two new species of the latter, and establishes four genera. Some of the records of Antarctic distribution are striking, e.g. that of *Esperiopsis villosa*, Carter, a form frequently recorded from high northern latitudes, but only from one intermediate station, viz. in deep water off the Azores; or that of *Sphaerotylus capitatus* (Vosmaer), an Arctic form, not reported from any intermediate locality—as yet. There are no fewer than nineteen plates illustrating this memoir, and there are twelve illustrating Mr. T. F. Jenkin's admirable account of the Calcarea, which teems with novelties, two new families, six new genera, and new species galore. Altogether, it cannot be doubted that the *Discovery* was true to her name.

[1] National Antarctic Expedition, 1901-4. Natural History. Vol. iv., Zoology. Pp. 280; 59 plates. (Printed by Order of the Trustees of the British Museum, 1908.)

THE DANISH NORTH-EAST GREENLAND EXPEDITION.

The account of the Danish North-east Greenland Expedition, given by Lieut. A. Trolle before the Royal Geographical Society on December 7, 1908, is printed in the January number of the society's journal, with several instructive illustrations and a map. During this expedition, which lasted two years, the little-known fjords and coast of north-east Greenland were explored, and much other valuable scientific work was accomplished, though the tragic death of the leader, Mylius Erichsen, and his two companions, Hagen and Brönlund, while on a sledge expedition, gives melancholy interest to it. In his lecture Lieut. Trolle only referred in general terms to the results of the scientific work carried on by the various observers during the expedition, as these will be published later, but the subjoined extracts from the paper, and the two illustrations here reproduced by permission of the Royal Geographical Society, will show that the expedition was marked by notable achievements.

The object of the expedition was to explore the last of the hitherto unexplored parts of Greenland. The whole of the west coast from 78° N. lat. to Cape Farewell is, as is well known, under the administration of Denmark. On the east coast there is a Danish colony at Angmasalik, while great parts of the coast had been mapped by Captains Holm, Garde, Ryder, and Amdrup. The stretch from 72° to 77° N. lat. had been explored, chiefly by Clavering and Sabine, by the *Germania* Expedition, by the English whaler Scoresby, and the Swedish explorer Nathorst. From 77° N. lat. and farther north the country, however, was practically unexplored, though the Duke of Orleans, on the *Belgica*, in 1905, had gone as far as 78½° N. lat., and from his ship had seen part of the outer islands.

The north-west had chiefly been explored by British and American expeditions, and the chief merit of the *Danmark* Expedition is that it has now supplemented what was still wanting in a knowledge of the outlines of Greenland by exploring the whole of the north-east coast.

The expedition consisted of twenty-eight members, and a characteristic feature of its organisation was the unusually large scientific staff and proportionately small crew, in the proper sense of the word. Thus there were six

cartographers (under Captain Koch, R.D.I.), two meteorologists, two zoologists, one botanist, one geologist, one hydrographer, one ethnologist, one physician, and two painters, besides one ice-master, two mates (both of whom belonged to the cartographers' staff), two engineers, two stokers, three Eskimo, and only three sailors. The scientific staff, however, had agreed to do the common ship's work besides their own special work, and, upon the whole, this arrangement worked rather satisfactorily.

FIG. 1.—Typical Fjord in the interior of King Frederick VIII. Land, Lat. 77° N.

The expedition left Copenhagen in June, 1906. On July 31 we saw our first ice, passing along the outer rim of some small hummocks, and on the next day we were at the border of the heavy pack-ice, as well as at the edge of the continental shelf. We knew this because our sounding-lead, which had just shown a depth of 1300 fathoms, now only showed 165. This seems to indicate that the chief branch of the south-going polar current runs across the shoals which are found everywhere outside the east coast of Greenland, but gradually lessens its strength over the deep sea.

We fought our way through the ice, one day, in spite of continuous efforts, only advancing a mile or two, the next day perhaps proceeding ten to fifteen miles. Twice we were surrounded by the ice for a period of thirty-six hours, and in the beginning it looked dangerous enough, but the conditions soon became better, and we got through.

On August 13—we had taken thirteen days for 140 miles—we reached land. At last we were sailing in the so-called shore-water, where the ice was very loose. We had reached as far north as we had ever dared to hope, but we tried to go still further in the shore-water. At Isle de France ($77\frac{1}{2}°$ N. lat.) we were stopped by impenetrable pack-ice, and had to go back, after having landed Captain Koch and several other cartographers, together with some big caches of provisions, at the most northerly point of the continent. The harbour place which we chose was one we had previously found inside the outer range of ice, and thus protected against the heavy pressure of the pack. We anchored the *Danmark*, the bow pointing southward, and with hawsers from the stem to the shore. After that we built some houses ashore, in which the various branches of scientific research were to be carried on, and the latter commenced.

The land of King Frederick VIII. is a beautiful mountainous country, in many places very much like Norway—the same picturesque valleys, the same deep fjords, with steep mountains, as high as 2000 feet on both sides, which have inspired our two painters, Fries and Berthelsen, numerous islets and rocks intersected with sounds. Everywhere there were traces of glaciers from the Ice period, but still earlier the country must have had a milder climate. The geologist, Jarner, found impressions of animals and plants from this period in the sandstone of the Malemuk Mountain, on Koldewey Island, and Hochstetter Foreland, and brought a fine collection home.

The country is not very wide. At 77° lat. the bottom of the interior fjords is reached about forty to sixty miles from the coast, and here generally a glacier is coming down from the inland ice. Farther north, at Jökel Bay, however, the inland ice goes directly into the sea, and the coast-line here consists of two ranges of islets. At the Malemuk Mountain there is some more free land, but it is narrower, and becomes lower and lower, until it finally disappears, and the inland ice again goes straight into the sea. Danmark Fjord is a big, mountainous fjord, eighty miles deep. Peary Land is not covered with inland ice; its southern coast is very low, and in the interior there are mountains to a height of 2000 feet. All this coast-line up to Cape Bridgeman and most of the edge of the inland ice has been mapped by the cartographers' staff, under Captain Koch, by theodolite measurements in a very exact manner. The country in the neighbourhood of the harbour has been mapped topographically, and the triangulation there is brought in connection with the German triangulation in 1870.

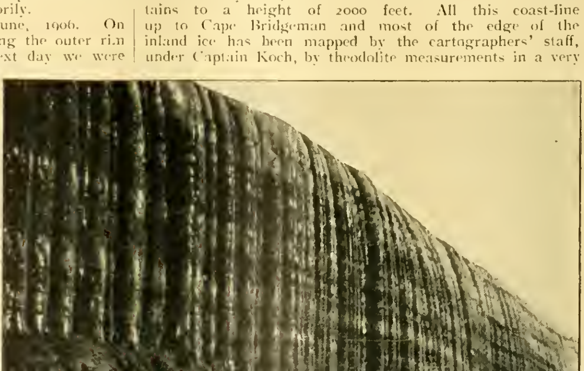


FIG. 2.—Edge of the inland ice, Lat. 77° N.

The most interesting geographical feature is the big

peninsula going eastward to 12° W. long., so that the outlet between Greenland and Spitsbergen of the great Polar basin thus becomes rather narrow. In this connection I shall just mention that Dr. Nansen, on account of his hydrographical observations in the Polar sea, supposed the existence of a suboceanic ridge between Greenland and Spitsbergen, and as the coast of Greenland here is quite flat, the probability is that such a ridge really exists.

The frontier of the inland ice is in some places quite steep, in other places you might have mounted the inland ice without knowing it. The glaciers are few and not very productive; still, the fjords are sometimes quite filled up with icebergs stranded on barriers in the mouths of the fjords.

In the interior, about forty miles from the edge of the inland ice, we found and mapped out some islands, nunalands, quite surrounded by the inland ice. Strange though it may sound, we here saw flowers and tracks of foxes; also in some places coal. During the winter the land was covered with snow, with only here and there some bare wind-swept spots. In the spring this snow partly evaporated, even with a temperature of 20° F. Then the water began to melt in the ravines, and, running under the glaciers, it formed the most fantastic ice-grottoes, where the light was broken into all colours through the crystal-like icicles.

The change into summer was quite sudden. Gradually the temperature of the snow had risen to zero, and then in one day it all melted. The rivers were rushing along, flowers were budding forth, and in the air the butterflies were fluttering. It was a lovely time, bringing hard work for the botanist Lundager and the zoologists Manniche and Johansen. The birds came nearly all on the same day, most of them even at the same hour. One day we had only had the ordinary ptarmigan and the raven; the next we had the sanderling, the ring-plover, the goose, the eider duck, and many others. Young sanderlings, icelandic ring-plovers, and Sabine gulls were found by Mr. Manniche, our indefatigable ornithologist, and fine specimens were brought home.

Of larger animals we found bears, musk-oxen, and wolves; foxes on land, and walruses and seals at sea. Bears are rather plentiful; we shot ninety in all, but musk-oxen and wolves are scarce. The five wolves we got were, I believe, all that were there. They were very meagre, and looked as if they had had nothing to eat for a long time. The snow-hares, which we found in great numbers, were very tame in April and May, and we could then go quite close to them. In the sea, the lakes, and the rivers animal life was not abundant. Some polar cod and inferior animals were usually the results of our net-fishing. In one of the lakes, however, salmon were plentiful.

Especially in the autumn we had the most beautiful Fata Morgana, with castles and ships high up in the clear air, while also the outlines of the coast were quite changed. The explanation of this is the great difference in temperature between the air and that of the new ice, which has still the temperature of the water. Our meteorologist, Mr. Wegener, studied these phenomena with great skill, and, moreover, took magnetic and electrical observations.

In the beginning of November the sun left us for good, the red colours of the southern sky grew fainter and fainter, while from the north darkness spread all along the sky. The temperature went down; in February and March it was as low as $-58°$ F., but at times it would again rise to 32° and even to 34°. Mr. Wegener sent up his kites and balloons throughout the whole winter, and the instruments often registered a much higher temperature in the upper strata of the air.

As a rule, the weather was calm and clear, but when the barometer sank the temperature rose, and the sky became overcast; we all sought shelter, for then we knew that a storm was coming, drifting the snow high above the masthead, and generally lasting for two or three days.

We spent two years in Greenland, and in these two years the weather was quite different. (The winter of 1906–7 was cold and calm, that of 1907–8 milder and more windy. The ice in the first winter grew 6 feet thick and broke up very late, in the second it was only 4 feet thick.) In the middle of February the sun came back, and May and June were a period of fogs and faint sea breezes. Otherwise, the wind was constantly from the north-west, coming from the high pressure of air which is found over the inland ice.

We found no living Eskimo, but everywhere along the coast up to the Danmark Fjord we found their tent stones, their meat caches, and in some places even winter dwellings. From kayaks and umyaks they have hunted the same animals which we found there, and besides whales and reindeer, which we did not find. Our ethnologist, Thostrup, made a very interesting collection of their various tools, &c.

Outside the coast the pack-ice was moving southward with the polar current, and we have mapped out the border of this pack-ice, which showed that the current is everywhere following the line of the outer islands and rocks, while in the waters inside this line pack-ice is rarely found. It was rather an interesting fact that we found great lanes in the ice from 80° to 82° N. lat. At the Malemuk mountain we found open water every time, in April, June, and November, the cause of which may be the current. The water in the fjords was mixed polar and gulf water, the gulf water probably running in along the supposed Greenland-Spitsbergen ridge and going southward with the polar current.

By making holes in the ice investigations were carried on even at a temperature of $-2°$ F. In a big fresh-water lake salt water was found, giving an odour of sulphide of hydrogen at the bottom. The lake must formerly have been a fjord, but the land rose so that the fjord became a lake. The geological conditions, as well as the fact that we found the carcase of a big whale at the border of this lake, seem to strengthen this theory. The tides were not very strong; the ordinary difference between high and low water was 5 feet.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The council of the Senate reports that it has had under consideration the position of the study of astrophysics in the University in connection with the offer of the Royal Society to give to the University the equipment of Sir William Huggins's observatory. It is of opinion that the time is opportune for giving further recognition in Cambridge to astrophysics. With the approval of the general board of studies, the council recommends to the Senate the establishment of a professorship of astrophysics, without stipend and limited to the tenure of office of the first professor.

Mr. H. O. Jones, of Clare College, has been approved as deputy for Sir James Dewar, the Jacksonian professor of experimental philosophy, during the Lent term of 1909.

An examination for minor scholarships in natural science and mathematics will be held in Downing College on Tuesday, March 2, and subsequent days. The examination in natural science will consist of paper work and practical work in (1) chemistry, (2) physics, (3) biology, (4) comparative anatomy, (5) botany. No candidate will be examined in more than three of the above subjects, and great weight will be given to proficiency in some one subject.

The qualifying examination for the mechanical sciences tripos is now held in June and at the end of November. The majority of the students take the examination in June, and experience has shown that the November examination is not much used. It is proposed to substitute for this latter an examination in November at which the best students—those who desire to take the tripos in two years—may pass the examination immediately on coming into residence.

MR. W. MORGAN has been appointed professor of motor-car engineering at the Merchant Venturers' Technical College, Bristol.

IT is announced in *Science* that Mr. G. M. Laughlin, of Pittsburg, has bequeathed 20,000*l*. to Washington and Jefferson College.

PROF. A. L. LOWELL, professor of political science in Harvard University, has been selected to succeed Dr. Eliot as president of the University. Prof. Lowell was born in Boston in 1856, and represents a family which has been prominent in Massachusetts affairs for a century.

A REUTER message from Berlin states that a professorship of aëronautics has been instituted at Göttingen University. The Minister of Education has appointed Prof. Prandtl, professor of applied mechanics at Göttingen, to lecture on the whole field of aëronautics.

CAPTAIN H. G. LYONS, F.R.S., Director-General of the Survey of Egypt, has been appointed lecturer in geography at the University of Glasgow from the beginning of the next academic year. Captain Lyons, who was vice-president of the geographical section of the British Association last year, has also been appointed by the West of Scotland Provincial Committee to be lecturer in geography to teachers in training.

As an instance of practical science at universities, the New York correspondent of the *Times* states that the Columbia Wireless Club, composed of students of the scientific department, will soon be prepared to inaugurate inter-collegiate wireless telegraphy with the students of Princeton University, New Jersey, and with the University of Pennsylvania. The novel experiments will be watched with interest as a method of teaching practical developments of science.

THE Board of Education has issued as a Blue-book (Cd. 4440) the reports from those universities and university colleges in Great Britain which participated in the Parliamentary grant for university colleges in the year 1906–7. The present volume is the first of a series in which all the reports in any one volume relate to the same academical year. It is much to be regretted that the Board of Education makes no attempt to collate the particulars provided concerning the seventeen institutions participating in the annual grant, which now amounts to 100,000*l*. It is at present a long and tedious process to compare, say, the income, the endowments, number of staff, and students of one institution with those of another. The arrangement of the volume, in fact, compares very unfavourably with the similar report of the U.S. Commissioner of Education published at Washington. The Board of Education may earn very easily the gratitude of students of the progress of higher education in this and other countries by including in the report of next year a series of tables summarising and comparing the educational condition of things in the universities and university colleges here concerned. It would then prove possible to understand more precisely why certain institutions are selected to receive a Treasury grant while others are precluded. For instance, we have before us the report for the session ending in August last of the East London College, which the Senate of the University of London recognises as a school of the University. The Treasury appears to be the only body which as yet has not accorded full recognition to the East London College of its status as the University College for East London. During the session 1905–6 the governors made a formal application for the college to participate in the Treasury grant. The inspectors appointed by the advisory committee of the Treasury visited the college and a favourable report was published. Yet no grant was awarded. If the tables suggested were available, it might be easier by careful comparison to understand this and other decisions. At present it is possible only to puzzle over the question. The number of students of university standing, the number of university successes, and the output of research work at the East London College seem to compare favourably with those of several of the university colleges receiving grants.

THE annual meeting of the Mathematical Association was held at King's College, London, on January 12. The association now consists of 406 members, representing an increase of more than 20 per cent. on the preceding year. The year which has just ended has been characterised by unusual activity. The formation of local branches has for many years been considered desirable, and a first move in this direction has been made by the formal recognition of a North Wales branch under the local secretaryship of Mr. T. G. Creak, of Llanberis. The association has appointed representatives on a joint committee with the Public Schools Science Masters' Association to consider the best means of coordinating teaching in mathematics and science. Dr. Bovey, F.R.S., read a paper on the mathematical training of technical students, in the course of which the necessity was pointed out of teaching such students to realise the value and utility of the theoretical training which they were receiving. Dr. Bovey considered the influence of the teacher, the text-book, the mental powers of the student, and carefully planned courses. The question further arose as to whether the teaching of technical students should be in the hands of mathematicians or engineers. While favouring the latter choice, Dr. Bovey quoted the opinion expressed by Prof. Slichter, who considered that the most competent teacher should be an engineering graduate, but that it would be necessary for him to have at least three years of post-graduate study in advanced mathematics. It was, however, impossible to induce graduates of technical schools to give this amount of time to preparation for instructional work when other fields of work offered such far better and more immediate prospects. Dr. Bovey thinks that in these circumstances the best plan at present is to secure an excellent mathematician, and to induce him to fit himself for the post by making himself in some degree familiar and sympathetic with the engineer's point of view and with the class of problems with which his students will have to deal in after life. Papers were subsequently read by Prof. Alfred Lodge on homography and cross-ratio, and by Prof. Bryan on the need of a new symbol, in approximate calculations, to denote digits the values of which are unknown, and which at present are represented by zeros. In his retiring address the latter directed attention to the serious danger of the extinction of the English mathematical specialist, and the necessity of fighting against this tendency. Engineers and others had plenty of problems for which all the resources of the mathematician were needed, but the latter found that this work interfered with his means of earning a livelihood. In defending the specialist against the attacks of the outside public—attacks essentially peculiar to Great Britain—Prof. Bryan pointed out that men who had specialised in part ii. of the mathematical tripos were prominently to the front on all committees appointed by the association for reforming mathematical teaching on common-sense, practical lines.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, Received August 10, 1908.—"Reciprocal Innervation of Antagonistic Muscles. Twelfth Note. Proprioceptive Reflexes." By Prof. C. S. **Sherrington**, F.R.S.

Whereas most reflexes are excited by environmental changes acting directly as agents on the receptive organs, by proprioceptive reflexes are meant reflexes excited habitually by the organism acting as agent upon itself, and thereby applying its own organs or parts as stimuli to its own nerves. In propioceptive reflexes the organism applies itself as a stimulus to itself. By its own act and in its own substance it excites one or more of its own receptor organs. In the bending of the knee, the organism, by executing the movement of a part of itself, supplies by that means an alteration of the condition of that part, and so stimulates certain reflex arcs, propioceptive arcs, arising in that part. The reaction thus excited is causally less directly related to the environment than are reflexes excited directly by the surrounding world. In other words, an important difference between propioceptive and other reflex reactions is that the former stand only in secondary relation to the external world, whereas the latter stand always in primary relation to it. One outcome of this is, as has been previously[1] pointed out, that the proprioceptive reflexes tend to ally themselves to, fuse with, and habitually reinforce other reflexes of exteroceptive and interoceptive origin.

It is shown in the present paper that the bending of

[1] Sherrington, "Integrative Action of the Nervous System." (London and New York, 1906.)

the knee causes, by stretching the extensor muscle of the knee, a reflex inhibition of the contraction of that muscle; the muscle assumes, in consequence, a greater length. This reaction is termed in the paper "the lengthening reaction." It is shown that the afferent nerve of the extensor muscle itself is absolutely indispensable for this reaction.

Conversely, there is "a shortening reaction." When the extensor muscle is either passively or by its own active contraction shortened, there occurs a change in the reflex arc of the muscle itself which makes its tonic length less. The result is that a transient contraction of the muscle becomes prolonged by a persistence of the tonic contraction, and this latter is the shortening reaction which appends itself to the transient contraction, however induced. The shortening reaction is, like the lengthening reaction, brought about by the afferent nerve-fibres of the muscle itself; these in some way regulate and adjust the reflex tonus of the muscle. If the afferent nerve-fibres of the muscle itself are severed, the "shortening reaction" and the long, persistent after-contraction which it effects are entirely wanting in the reactions of the muscle. This is so whether the afferent fibres have been severed only a few days or for three months.

Attention is directed to the similarity between these proprioceptive reflexes of the extensor muscles as studied in cat and dog and the reactions observed by v. Uexküll and others in tonic preparations of various invertebrate muscle, *e.g.* the retractor muscle of Sipunculus. The similarity is close enough to leave little doubt that the phenomena achieve the same practical end.

Mathematical Society, January 14.—Sir W. D. Niven, president, in the chair.—The canonical form of a linear substitution: H. **Hilton**.—Researches concerning the solution of the quintic equation: J. **Hammond**.—Octavic and sexdecimic residuacity: Lieut.-Colonel A. **Cunningham**.—Change of the variable in a Lebesgue integral: Dr. E. W. **Hobson**.—Abel's extension of Taylor's series: Rev. F. H. **Jackson**.—Note on the evaluation of a certain integral containing Bessel's functions: Prof. H. M. **Macdonald**.

Manchester.

Literary and Philosophical Society, December 15, 1908.—Prof. H. B. Dixon, F.R.S., president, in the chair.—The volatility of radium A and radium C: W. **Makower**. The experiments described were carried out with a view to determine the volatility of radium A, and also of re-determining that of radium C under different conditions to see whether the volatility of this product was influenced by its environment. The volatilisation point of radium A was found to be 900° C. Radium C was found to begin to volatilise at a temperature between 700° C. and 800° C. When deposited on a platinum or nickel surface the volatilisation was found to be complete at 1200° C., whereas when deposited on quartz the volatilisation was still incomplete even at 1300° C. The same result was found whether the deposit had been previously dissolved in hydrochloric acid or not. Finally, experiments were made to see whether radium C is charged at the moment of its production from radium B. Experiments in which the emanation exposed to an electric field was contained in a furnace at 950° C. failed to reveal any evidence of a charge carried by radium C.—Note on the production of white ferrous ferrocyanide: R. L. **Taylor**. A little solution of either hydrosulphurous acid or of sodium hydrosulphite, added to a solution of ordinary ferrous sulphate, frees the solution so completely from any trace of a ferric salt that it gives a pure white precipitate with potassium ferrocyanide, instead of the light blue precipitate usually obtained. The white precipitate rapidly turns blue when exposed to the air, and it is also instantly turned blue when ordinary tap-water is added to it, owing to the oxygen which is dissolved in the water. Water which has been previously well boiled to expel dissolved air does not alter the colour of the precipitate. Hydrosulphurous acid or sodium hydrosulphite will turn Prussian blue perfectly white.

January 12.—Prof. H. B. Dixon, F.R.S., president, in the chair.—The influence of light on the coloration of certain marine animals (Hippolyte, Wrasses): Dr. F. W. **Gamble**. The author gave an account of his work on the colour-physiology of Hippolyte (the Æsop-prawn), and of one of the common British wrasses (*Crenilabrus melops*). Hippolyte is a variably coloured prawn, each colour variety agreeing closely with the tint of the weed on which it is found, and upon which it feeds. Previous experiments made jointly by the author and Prof. Keeble have shown that this remarkable sympathetic coloration is in all probability not inherited—*i.e.* the colour varieties do not necessarily breed true, but that the harmonious motley exhibited by this varying species is the outcome of a very special colour adaptation undergone by each individual, and that the coloration is controlled largely by the colour of the weed at the time when the young prawn settles down upon it, after a brief free-living larval existence. The results of more recent researches by the author on this subject have shown that the amount of pigment in the larva varies, in all races but the green one, with that in the parent. The more there is of it in the parent, the more highly coloured is the offspring. Green parents, however, gave rise to three kinds of broods:—(1) highly coloured ones like those of brown parents; (2) pale ones; and (3) a mixed brood, containing coloured to colourless in the proportion of 3 : 1. Coloured light experiments yielded an unexpected result, namely, a complementary colour to that of the light employed. Thus, under the influence of green light for a month, Hippolyte lost its yellow pigment and became brilliantly scarlet, while under red light it became green. In both cases the animal at starting was of a transparent and almost colourless appearance. The value of this complementary colour production (which does not appear to have been recognised in animals previously) upon the problem of the coloration of Hippolyte was briefly discussed.

Paris.

Academy of Sciences, January 11.—M. Bouchard in the chair.—The families of Lamé resulting from the displacement of a surface which remains invariable in form: Gaston **Darboux**.—A general method of preparation of the monoalkyl, dialkyl, and trialkyl-acetophenones: A. **Haller** and Ed. **Bauer**. The ketone (methyl, ethyl, or propylphenylketone) is dissolved in pure dry benzene, an equimolecular proportion of finely divided sodium amide added, and heated on the water bath until a clear solution is obtained. The alkyl bromide or iodide is added drop by drop to this solution. By this method the following ketones have been prepared and their properties given in detail:—trimethylacetophenone, ethyldimethylacetophenone, methyldiethylacetophenone, triethylacetophenone, methylethylpropylacetophenone, and allyldimethylacetophenone.—Dirichlet's series: Harald **Bohr**.—The double integrals of the first species attached to an algebraic variety: Francesco **Severi**.—A theorem on differentials: W. H. **Young**.—A particular critical point of the solution of the equations of elasticity in the case where the forces on the border are given: A. **Korn**.—The theory of the moon: H. **Andoyer**.—A dynamometer for testing motors with large angular velocity: M. **Ringelmann**. The defects of the Prony brake for testing high-speed motors are reviewed, and a new form of dynamometer described, by means of which the total energy furnished at each instant by the motor can be read off, and is at the same time recorded.—A formula for velocity applicable to propulsion in air: Alphonse **Berget**. A modification of a formula devised for the velocity of steam vessels. $V = C\sqrt[3]{\frac{F}{S}}$, where V is the velocity in myriametres per hour, F the horse-power, S the surface of maximum section of the balloon in square metres, and C the coefficient of utilisation. The latter is shown to vary between 3·0 and 5·0 for various types of steerable balloon.—The radiation of cerium oxide: M. **Foix**. Some experiments are cited in support of the theoretical relation given in an earlier paper.—A modification of the phonograph: M. **de Pezzer**.—Aqueous solutions of pyridine: E. **Baud**. The freezing points of aqueous solutions of pyridine varying in concentration from 5 per cent. to 100 per cent. are given. The densities and refractive indices of these solutions were also measured, and also the heat of solution of pyridine in a large excess of water. Only two hydrates of pyridine, with two and six molecules of water, are indicated by these

experiments.—Lævo-campholic acid: Marcel **Guerbet.** A good yield of this acid is obtained by heating *l*-borneol with dehydrated caustic potash in sealed tubes. The acid has a rotation $\alpha_D = -49 \cdot 1$.—The alkaline reduction of *o*-nitrodiphenylmethane: P. **Carré.** Reduction with zinc dust and caustic soda gives *o*-hydrazodiphenylmethane and *o*-aminodiphenylmethane.—The influence of aëration on the formation of volatile products in alcoholic fermentation: E. **Kayser** and A. **Demolon.** The amounts of aldehyde, acids, and esters are all modified by access of air to fermenting liquids. The presence of air, therefore, is an essential condition for the production of bouquet in wine.—The anatomy of the human thymus: Henri **Rieffel** and Jacques **Le Mée.** The two lobes of this gland are not united, but are easily separable, at least in the case of newly born infants. The contact of the thymus with the thyroid gland is not exceptional; this contact has been observed in 20 per cent. of the glands examined.—The rudimentary organs of the larvæ of the Muscidæ: J. **Pantel.**—Contribution to the study of the singing voice: M. **Marage.** Curve tracings are given showing the changes taking place in the transition stage between chest and head notes.—The action of ink on the photographic plate: Guillaume **de Fontenay.** A criticism of some experiments by M. Darget.—The treatment of Baleri in the horse by orpiment: A. **Thiroux** and L. **Teppaz.** It is now shown that there are three forms of trypanosomiasis, curable by treatment with orpiment, infesting horses in Gambia, Souma, and Baleri. The diseases caused by *T. congolense* and *T. brucei* still have to be studied from this point of view.—Studies of cancer in mice. The different types of tumours appearing in the same growth: L. **Cuénot** and L. **Mercier.**—An enormous urinary calculus in man: A. **Guépin.** This calculus was removed from a man sixty-eight years of age, measured 8·5 cm. by 6·8 cm. by 4·5 cm., and weighed 220 grams.—The source of the Bise at Thau: MM. **Chevallier** and **Sudry.**

DIARY OF SOCIETIES.

THURSDAY, JANUARY 21.

ROYAL SOCIETY, at 4.30.—Syntonic Wireless Telegraphy; with Specimens of Large Scale Measurements: Sir O. Lodge, F.R.S., and Dr. A. Muirhead, F.R.S.—The Leakage of Helium from Radio-active Minerals: Hon. R. J. Strutt, F.R.S.—The Mobilities of the Ions produced by Röntgen Rays in Gases and Vapours: E. M. Wellisch.—Determination of the Surface Tension of Water by the Method of Jet Vibration: Prof. N. Bohr.—The Photo-electric Fatigue of Zinc, II.: H. Stanley Allen.

LINNEAN SOCIETY, at 8.—The Genus Nototriche, Turcz: Arthur W. Hill.—The Longitudinal Symmetry of Centrospermeæ: Dr. Percy Groom.

ROYAL INSTITUTION, at 3.—Mysteries of Metals: Prof. J. O. Arnold.

INSTITUTION OF MINING AND METALLURGY, at 8.—A Theory of Volcanic Action and Ore Deposits, their Nature and Cause: Hiram W. Hixon.—An Instance of Secondary Impoverishment: H. H. Knox.—The Silver Islet Vein: Walter McDermott.

FRIDAY, JANUARY 22.

ROYAL INSTITUTION, at 9.—The World of Life: as Visualised and Interpreted by Darwinism: Alfred Russel Wallace, O.M., F.R.S.

PHYSICAL SOCIETY, at 5.—The Effective Resistance and Inductance of a Concentric Main, and Methods of Computing the Ber and Bei and Allied Functions: Dr. A. Russell.—(1) The Luminous Efficiency of a Black Body; (2) The Use of the Potentiometer on Alternate Current Circuits: Dr. C. V. Drysdale.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Experiments on a Diesel Engine: W. E. Fisher and E. B. Wood.

MONDAY, JANUARY 25.

ROYAL SOCIETY OF ARTS, at 8.—Electric Power Supply: G. L. Addenbrooke.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A Proposed North Polar Expedition: Captain Roald Amundsen.

INSTITUTE OF ACTUARIES, at 5.—On an Approximate Method of Valuation of Whole-life Assurances, grouped according to Attained Ages, with Allowance for Selection, on the Basis of O[M] Mortality: E. H. Brown.

TUESDAY, JANUARY 26.

ROYAL INSTITUTION, at 3.—Albinism in Man: Prof. Karl Pearson, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Annual General Meeting. President's Address: The Relation of Anthropology to Classical Studies: Prof. W. Ridgeway.

MINERALOGICAL SOCIETY, at 8.—On the Identity of Poonahlite with Mesolite: Dr. H. L. Bowman.—Contributions to the Study of Parallel Growths: Dr. S. Kreutz.—Note on the Spontaneous Crystallisation of Solutions in Spherulites: J. Chevalier.—On a Method for Studying the Optical Properties of Crystals: the late Dr. H. C. Sorby, F.R.S.—Some Additional Localities for Idocrase in Cornwall: G. Barrow and H. H. Thomas.—Detrital Andalusite in Tertiary and Post-Tertiary Sand: H. H. Thomas.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: High Speed on Railway-curves: J. W. Spiller.—A Practical Method for the Improvement of Existing Railway-curves: W. H. Shortt.

WEDNESDAY, JANUARY 27.

GEOLOGICAL SOCIETY, at 8.—The Conway Succession: Dr. Gertrude L. Elles.—The Depth and Succession of the Bovey Deposits: A. J. Jukes-Browne.

ROYAL SOCIETY OF ARTS, at 8.—The Part played by Vermin in the Spread of Disease: J. Cantlie.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

SOCIETY OF DYERS AND COLOURISTS, at 8.—The Locust Bean, and its Practical Application: M. C. Lamb and F. J. Farrell.—Chlorinated Wool: H. P. Pearson.

THURSDAY, JANUARY 28.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Action of the Venom of *Sepedon haemachates* of South Africa: Sir Thomas R. Fraser, F.R.S., and Dr. J. A. Gunn.—The Colours and Pigments of Flowers with Special Reference to Genetics: Miss M. Wheldale.—The Variations in the Pressure and Composition of the Blood in Cholera; and their Bearing on the Success of Hypertonic Saline Transfusion in its Treatment: Prof. Leonard Rogers, I.M.S.—The British Freshwater Phytoplankton, with Special Reference to the Desmid-plankton and the Distribution of British Desmids: W. West and G. S. West.

ROYAL INSTITUTION, at 3.—Mysteries of Metals: Prof. J. O. Arnold.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Parallel Operation of Alternators: Dr. E. Rosenberg.

ROYAL SOCIETY OF ARTS, at 4.30.—Some Phases of Hinduism: Krishna Gobinda Gupta.

FRIDAY, JANUARY 29.

ROYAL INSTITUTION, at 9.—Improvements in Production and Application of Gun-cotton and Nitro-glycerine: Sir Frederick L. Nathan.

SATURDAY, JANUARY 30

ROYAL INSTITUTION, at 3.—Sight and Seeing: Sir Hubert von Herkomer.

ESSEX FIELD CLUB, at 6 (at Essex Museum of Natural History, Romford Road, Stratford).—Subsidence of Eastern England and Adjacent Areas: W. H. Dalton.—Some Notes on "Moorlog," a Peaty Deposit dredged up in the North Sea: H. Whitehead and H. H. Goodchild.

CONTENTS.

THURSDAY, JANUARY 28, 1909.

RELIGIOUS AND SEXUAL PSYCHOLOGY.

(1) *Völkerpsychologie, eine Untersuchung der Entwickelungsgesetze von Sprache, Mythus und Sitte.* By Wilhelm Wundt. Zweiter Band, Mythus und Religion, zweiter Teil. Pp. viii+481. (Leipzig: W. Engelmann, 1906.) Price 11 marks.

(2) *Das Geschlechtsleben in der Völkerpsychologie.* By Otto Stoll. Pp. xiv+1020. (Leipzig: Veit and Co., 1908.) Price 30 marks.

(1) THIS volume contains a single chapter of Wundt's great work, and deals ostensibly with ideas as to the soul; in reality, however, its scope is much wider, and only one of the four parts actually deals with animism. The second part deals with animism at the outset, but passes on to discuss magic and fetichism; the third discusses totemism, tabu, sacrifice, and the cult of ancestors; and the fourth, again, approaches the subject-heading of the chapter in dealing with demons, vegetation "spirits," and tutelary deities.

Under certain conditions a work of this description would be invaluable, but the conditions are not fulfilled in the present case. In the first place, there must be an adequate monographic treatment of the sphere with which such a monumental work as the present deals, and monographs are far too infrequent in the field of comparative religion; to make matters worse, the author has not even consulted such as exist—he writes on sacrifice and magic without mentioning the indispensable studies on these subjects by Hubert and Mauss. In the second place, the author, if he is not an ethnologist by profession, must have clear-cut ideas on the subjects of which he treats, and define as rigidly as possible the terms which he employs. But in the present volume we find pages of discussion on magic, fetichism, totemism, and tabu, but nowhere an adequate definition of any of these terms, though they are far from unambiguous.

The lack of definition makes itself particularly felt in the pages on totemism; the author includes under totems not only totems proper, kin or individual, but also all the animals enumerated by Frazer in the "Golden Bough" under the heading of animal cults. He commits himself to the assertion that totems are originally soul-animals (Seelentiere), that is, animals inhabited by the souls of ancestors. One of the central features of South African totemism, if totemism it be, is the belief that the souls of dead chiefs pass into or become the totem animals of their kin; but so far from this being a universal belief, the totem in the greater part of Australia is neither an ancestor nor has any connection with ancestors, and where, as in the Central tribes, totems appear as akin to ancestors, they are not "Seelentiere," and the totemism is not primitive, according to the view most commonly held; in fact, some recent researches by P. W. Schmidt go to show that north Australian totemism is really derived from New Guinea.

To say that the work is not one which the student of comparative religion can read with profit would be to do great injustice to the book with which we are dealing; often the specialist in one branch owes invaluable suggestions to the unbiassed attitude of the specialist of another sphere; but the work is one to be read critically. We may be doing injustice to the distinguished author, but the comparative scarcity of examples and references to authorities suggests that the solution of many problems has been attacked with a quite insufficient preparation. In many places a characteristic Teutonic tendency to abstract argument manifests itself, and throughout the work we feel that the author stands rather far from primitive man, with whom he is largely concerned; if he were intimately acquainted with one uncivilised race his discussion of many points would gain immeasurably. The first part of this work—on language—has gained immensely by the author's careful revision, and we may hope that he will be able to give us in a second edition of the present part as many improvements as in the second edition of the earlier part.

(2) In this series of twenty-six lectures Dr. Stoll deals with many problems which at first sight seem to have little relation to the subject of the book, and in point of fact only one-third of them deal with strictly sexual questions. The author begins by a general account of sexual life in the animal world, and illustrates the *rôle* played by the various senses, sexual dimorphism and other points; he then proceeds to take the senses in man one by one, and discusses the factors of sexual life under these five heads. The category of sight, for example, covers such various subjects as the fattening of women in Africa, skull and other deformations, tatu and body scarring, treatment of the ear, nose, hair, beard, teeth, &c., body-painting and ornaments, amulets, &c., and in the chapters dealing with these subjects we find such unexpected themes as scalping, pariah castes, and mourning colours.

In the nineteenth chapter we approach more specifically sexual questions, such as circumcision, in connection with which Dr. Stoll discusses the subincision of the Central Australian area; it may be noted that he is mistaken in his account of the distribution of the operation, which he gives as "the interior of Queensland, New South Wales and South Australia, with a large part of the north and west." In point of fact, in Queensland it is found only in the west, and in the extreme north-west corner of New South Wales; more than one map of the distribution of the practice has been published.

In his discussion of the origin of circumcision Dr. Stoll rejects, as may be imagined, the common theories that cleanliness or other practical motives played any part; but apart from generalities about the cruelty of primitive man, the mystical nature of blood customs, &c., he has no suggestion to make. It is a well-known fact that peoples in the lower stages of culture sometimes emphasise instead of concealing the genital organs; and it is possible that in some cases this was a motive for circumcision; but in view of the fact that we find the knocking out of teeth taking the place of operations on the genital organs in, for example, the east of Australia, it seems reasonable to

look for some deeper meaning, such as that for which Dr. Frazer argued a year or two ago in the *Independent Review*.

In the visual section is included also a discussion of the dance, commonly unisexual in the lower stages of culture, and of phallic emblems and amulets. Under the heading of hearing we have a discussion of the *rôle* of music in sexual life, while the next chapter, *mirabile dictu*, is devoted to a classification of "gentlemen's stories" and allied themes.

In dealing with the sexual importance of the sense of smell Dr. Stoll gives an interesting discussion on the classification of odours, and has also a good deal to say on the subject of racial fœtor. The last chapter deals with the sense of touch; it includes a discussion of kissing, of specific sexual acts, and of inversion and perversion. It is clear that a work of this sort, if it is to be in any sense complete, demands encyclopædic knowledge, and can only be successfully carried through with the aid of numerous monographs on the various questions. In recent years a number of general works on the sexual life of primitive peoples have appeared, together with a certain number of monographs on special points such as inversion in Eastern Asia. Until the number of the latter has considerably increased it will hardly be possible to produce anything more than a sketch of the subject with which Dr. Stoll has dealt; he would probably be the first to recognise the fact. He is, however, as he informs us in the preface, chiefly concerned to classify from the point of view of psychology; and as a classification of anthropological facts Dr. Stoll's work is as useful as it must have been laborious.

That these two works should both have been produced in Germany is no accident. The Teutonic spirit aims at an all-embracing philosophy, whether the subject be metaphysical or something less abstruse. It is perhaps fortunate that both in England and France the feeling in anthropological circles is in favour of knowing all about something rather than a little about everything. Classification of knowledge may be the ultimate goal; at the present day we have still to lay the foundations of such a classification.

N. W. T.

THE BONE MARROW.

The Bone Marrow: a Cytological Study. By W. E. Carnegie Dickson. With 49 photomicrographs and 12 coloured plates by Richard Muir. Pp. xii+160. (London: Longmans, Green and Co., 1908.) Price 2*l.* 2*s.* net.

THE first part of the book contains a brief description of the histological methods employed, followed by a description of the various types of marrow and of the changes it undergoes in disease.

The second part deals with the cytology of the marrow, which the author has studied with the object of observing pathological changes in the cells. The reviewer is inclined to think that in the present state of our knowledge this attempt is premature. The changes illustrated on plate iii., Figs. 1–5, may be degenerative, but some of the nuclei in these cells have a remarkable resemblance to those figured by L. H. Huie in her papers on Drosera (*Q.J.M.S.*, vols. xxxix. and xlii., n.s.), where the cells were subjected to purely physiological stimuli. So also the type of eosinophil cell on plate iii., Fig. 1, No. 14, and Fig. 3, No. 23, is frequently met with in the tissues. Its nucleus somewhat resembles that of an exhausted nerve cell (Mann, *J. of Anat. and Physiol.*, vol. xxix., 1894), and is quite possibly a physiological appearance. Much more work on the lines of these three most important papers must be done before we can safely begin the study of intracellular pathology.

On p. 36 the author explains shortly the opinions of Dominici and Pappenheim on the parent cell of the neutrophil myelocyte, a cell called by the former non-granular basophil myelocyte, and by the latter identified with Ehrlich's large lymphocyte. He illustrates his idea of this cell in plate i., Figs. 10, 11, 12. The cells in each of these figures are quite different from those pictured by Dominici, Pappenheim and Ehrlich in the works cited in the bibliography. They are typical large mononuclears (Ehrlich's). It is a curious fact, but neither in the coloured plates nor the schemes on plate xii. is there a single example of an undoubted large lymphocyte, one of the most characteristic cells of the marrow, and common to it and the other blood-forming organs.

On the same page he says of this cell:—

"According to my own observations this staining reaction" (of the cytoplasm) "varies within somewhat wide limits, all gradations from a definite blue to a pale pink being obtainable with methylene blue and eosin."

This passage indicates that the technique used by the author is quite unsatisfactory. Every histologist knows that most things, especially the cytoplasm, can be stained with eosin. On the other hand, the cytoplasm of these cells (large lymphocytes, lymphocytes, large mononuclears) has a marked affinity for basic dyes, as can be seen in preparations stained with Pappenheim's pyronin methyl green mixture, or with toluidin blue or polychrome methylene blue, and differentiated with weak acetic acid. Ehrlich pointed out many years ago that successive methods, such as hæmatoxylin and eosin, or eosin and methylene blue, which the author has worked with, are quite inadequate for the study of the blood. The reviewer finds that in order to demonstrate neutrophil granules regularly in sections and wet fixed films, the acid and basic dyes must be used simultaneously, and their proportions so adjusted that the granules are stained with the acid dye while the cytoplasm of the adult leucocyte and myelocytes is unstained, and that of the promyelocytes and large and small lymphocytes is stained with the basic dye.

Judged by this standard, many of the figures in the coloured plates, although very beautiful, are worthless for the object in view. Thus, in plate i., Fig. 13, there are lymphocytes with eosin-stained cytoplasm. In plate iii., Figs. 1 and 2, the nuclear chromatin is blue to violet, all else pink. The majority of the cells in plate iii., Fig. 4, and the large cells with basophil cytoplasm in plate vii., Fig. 10, are labelled myelocytes, but their granules are not shown, and therefore it is not proved that they are myelocytes.

The introduction of the term premyelocyte (p. 49) for the non-granular cell with basophil cytoplasm which gives rise to the myelocytes is most regrettable, first because too many names have been given to this cell already, and, secondly, because the very similar word promyelocyte has already been in use for some time to describe cells like those in plate i., Fig. 8, Nos. 3, 4, 5, *i.e.* early myelocytes with granules in a still basophil cytoplasm (Pappenheim). Likewise the term intermediate myelocyte is both clumsy and unnecessary when the word metamyelocyte is already well established (Pappenheim).

From what the author says on pp. 40, 48, 62, and his figure on plate xii., it is obvious that he confuses the Reizungsformen with the large mononuclears. They are absolutely distinct cells, only differing from the young megaloblast in that the narrow rim of cytoplasm is extremely basophil and free from hæmoglobin.

The most valuable thing in this book is the series of plates illustrating the author's macroscopic bone-marrow preparations. These are jewels of a pathological museum. Taken as a whole, the book contains very little that is new, and is not a serious contribution to science.

PROGRESS OF CLIMATOLOGY.

Handbuch der Klimatologie. By Dr. Julius Hann. Band i., Allgemeine Klimalehre. Dritte wesentlich umgearbeitete und vermehrte Auflage. Pp. xiv+394. (Stuttgart: J. Engelhorn, Bibliothek geographischer Handbücher, 1908.)

A NEW edition of Prof. Hann's well-known handbook of climatology will be greeted with pleasure by geographers and meteorologists alike. The second edition has been rendered accessible to English readers by Prof. De Courcy Ward's translation. The present edition has been largely extended and revised, and much recent work has been incorporated in it. The numerous references to original papers, a feature which the book shares with its fellow, the "Lehrbuch der Meteorologie," are specially welcome. They render the work no mere text-book, but a veritable encyclopædia to which the student will turn as a matter of course to ascertain what has been accomplished by others in the field in which he proposes to work.

In external features the book has gained considerably from an increase in the size of the page which makes it possible to set out tabular matter in more comprehensive style. The more detailed subdivision of the material into books, chapters and sections is also of great assistance to the reader.

A comparison of the two editions is of the nature of a survey of the progress of climatology in the past decade. Perhaps the most striking development lies in the greater prominence given to the question of radiation, which finds expression in an introductory section on solar radiation and in a considerable extension of the chapter on the solar or mathematical climate. Langley's work on the distribution of energy in the solar spectrum and the researches on the determination of the amount of radiation received from the sun, which are associated with the name of Ångström, are dealt with, and open what is practically a new chapter in the science of climatology. The question of cyclical changes of climate has also come to the forefront in recent years, and the chapter thereon, with its numerous references, forms a useful summary of the present state of our knowledge of this question and of the allied one of the dependence of variations of terrestrial climate on solar phenomena. In this connection a bibliography of series of observations extending over long periods, many of them to the second half of the eighteenth century, is of great value. Prof. Hann endorses the generally accepted view that all available meteorological records show no permanent change of climate. On the wider question of a change of climate within historic times he preserves an open mind, and considers the usual statement that our climate is not changing to be a no more justifiable deduction from known facts than the reverse opinion.

Increased space is devoted to the consideration of methods of computing averages for temperature and rainfall from incomplete or short series of observations which shall be comparable with those deduced from long periods, a question which is of great importance in forming an estimate of the climatic factors of regions which have only recently been opened to civilisation. Finally, we mention an entirely new chapter on the great climatic zones of the globe, which gives a concise summary of the main features of the climate of each of the regions into which the earth's surface may be divided. We look forward with interest to the appearance of the second and third volumes of the book, which are to deal with the climates of special regions in greater detail.

R. G. K. L.

SOME NEW TEXT-BOOKS OF INORGANIC CHEMISTRY.

(1) *Cours de Chimie inorganique.* By F. Swarts. Pp. iv+706. (Paris: Librairie scientifique A. Hermann, 1908.) Price 15 francs.

(2) *A Text-book of Inorganic Chemistry.* By A. F. Holleman. Issued in English in cooperation with H. C. Cooper. Pp. viii+502. Third English edition, partly re-written. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1908.)

(3) *General Chemistry for Schools and Colleges.* By Dr. Alexander Smith. Pp. xiii+529. (London: G. Bell and Sons, 1908.) Price 6*s.* 6*d.* net.

(4) *The New Matriculation Chemistry, specially adapted to the London University Matriculation Syllabus.* By Dr. G. H. Bailey. Pp. viii+528. Sixth impression, fourth edition; revised by H. W. Bausor. (Cambridge: University Tutorial Press, Ltd., 1908.) Price 5*s.* 6*d.*

(1) THE "Cours de Chimie," so the author states in the preface, is a reproduction of his course on general chemistry. Theoretical questions are discussed as they happen to occur, and, it may be added, these theoretical questions are treated in a manner which few first-year students of an English University would grasp. It speaks well for the previous training in mathematics and physics of the Belgian schoolboy that on

entering the university he can follow a course which involves the thermodynamics of chemical reactions. This is done, we are told :—

"Because it furnishes the demonstration of the law of Guldberg and Waage and of the principle of Le Chatelier, which, concurrently with the atomic hypothesis and the hypothesis of Arrhenius, serve as the basis of my teaching. It gives a precise notion of affinity, the primordial cause of all chemical transformations, and it affords an opportunity for discussing the significance of the principle of maximum work. Furthermore, I have wished to combat the unfortunate tendency often observed among engineering students, whose studies are largely mathematical, to consider chemistry as an empirical and descriptive science which appeals mainly to the memory."

In the latter object we should think Prof. Swarts has been successful, and we are only doubtful whether the student may not carry away the impression that chemistry is a branch of mathematics. Although somewhat advanced, according to our notions of an introductory course, the book is clearly written and printed in excellent type. It is also well illustrated, and the purely chemical information seems up to date.

(2) In writing a text-book of moderate dimensions which shall at the same time embrace the most recent developments of the subject there is a risk of superficiality, a risk which the author has not altogether succeeded in avoiding. Short sections are devoted to the mass law, the phase rule, transition temperatures, electrolytic dissociation, the theory of valency or valence, as Americans call it, induced reactions, colloids, the new gases of the atmosphere, radio-active elements, the rare earths of the cerium group, &c. The more elementary chemical information has to suffer occasionally in consequence. We would instance the treatment of flame, which is carried no further than that of the most elementary text-book. On the other hand, it must be admitted that the author has produced, if not a suggestive, at least an interesting book, and has managed to collect in a small compass a large amount of information. The appearance of a third edition is a sufficient testimony of public appreciation. As proofs of composition we should like to see the electrolysis of water and hydrogen chloride disappear once and for ever from the text-book. The first is untrue, and is usually contradicted in a later part of the book; but if the first is true the second can afford no satisfactory evidence of the composition of hydrogen chloride because water is invariably present.

We should also like to see consigned to the same limbo of questionable statements Lavoisier's authorship of the principle of the conservation of mass. We might with equal truth assign to him the statement of the principle of the conservation of energy, since he was the first to attach to the imponderable matter of heat or caloric a real and permanent existence. What are the facts? Simply that matter has for ages been regarded by the majority of philosophers as indestructible, and Lavoisier did no more than accept the principle and base his experiments upon it. Jean Rey, in his somewhat figurative style, states that "the weight with which each portion of matter is endowed at the cradle will be carried with it to the grave," whilst Boyle expresses himself still more clearly :—

"For it far exceeds the power of merely natural agents (and consequently of the fire) to produce anew so much as one atom of matter which they can but modifie and alter not create, which is so obvious a truth that almost all sects of philosophers have deny'd the power of producing matter to second causes."

Let us compare this statement with that of Lavoisier ("Elements of Chemistry," vol. i., p. 226, Kerr's translation) :—

"We may lay it down as an incontestable axiom, that in all the operations of art and nature, nothing is created; an equal quantity of matter exists both before and after the experiment; the quality and quantity of the elements remain precisely the same, and nothing takes place beyond changes and modifications in the combination of these elements. Upon this principle the whole art of performing chemical experiments depends. We must always suppose an exact equality between the elements of the body examined and those of the products of its analysis."

But this is nothing more than the axiom laid down by Boyle! That Lavoisier actually weighed his materials and products scarcely gives him the claim put forward by Prof. Holleman that he first introduced the principle of the conservation of mass into chemistry. Nor is Prof. Holleman more correct in saying that Lavoisier "assumed that gravity is an inseparable attribute of all matter." What about the *imponderable* matter of heat!

(3) Those who are acquainted with the many excellences of Prof. Alexander Smith's "Introduction to General Chemistry" will question the wisdom of publishing an abridgment of it for the use of schools and colleges. For the new volume is an abridgment in the sense that the arrangement, the illustrations, and page after page of the text are taken without modification from the original. This is unfortunate, because, if the matter is to be simplified for younger students, it must be expanded as well as curtailed, which is not the case. For example, of all subjects which demand clear and explicit treatment at considerable length, that on the measurement of gases should stand among the first. Yet we find the twelve pages forming an excellent chapter on the subject in the original cut down to less than five pages in the abridgment. The same is true of the section on catalysis; but the danger of this process is perhaps best illustrated on p. 89, where the expression "critical temperature" occurs without, so far as we can ascertain, any further explanation, whereas the original volume contains a very lucid account of critical phenomena in general. It seems scarcely worth while to issue at so small a difference in cost a volume so distinctly inferior to the original, which we regard, apart from the introductory chapters, as one of the best books on the subject.

(4) Little need be said about Dr. Bailey's "Matriculation Chemistry." It has long been recognised as a standard work of the "Tutorial" series. A book of such substantial proportions should, we think, carry the student not only well through the matriculation stage, but very considerably beyond it. The book is well arranged and full, almost too full, of information,

clearly set forth, and illustrated by numerous experiments and well-drawn diagrams. Its weak point, if it has a weak point, is that it is a little too didactic and not sufficiently suggestive. There is little to stimulate the student to ask himself or other people questions relating to what he has read, which may be partly due to the rather crowded mass of information. To take one example, the action of steam on various metals is described; some react and others do not. No comment is made or question raised as to the reason of this remarkable difference, and the student must be satisfied with the bare fact. J. B. C.

OUR BOOK SHELF.

The Theory and Practice of Bridge Construction in Timber, Iron and Steel. By Morgan W. Davies. Pp. viii+594. (London: Macmillan and Co., Ltd., 1908.) Price 12*s*. net.

THIS work is based upon notes of lectures delivered by the late Mr. Davies to students of civil engineering at the Swansea Technical College, and the aim the author had in view was to collect together a series of easily understood rules to enable problems of bridge design to be solved by graphical and analytical methods. The first two chapters are devoted to the routine problems connected with the bending moments and shearing forces of simple and built-in beams; then follow a series of chapters on stresses in the bars of framed structures; all the trusses which have been generally used in bridge construction are considered; in some cases graphical methods are employed, and in others, such as lattice girders and bow-string girders, analytical methods.

Special chapters are devoted to such subjects as the moment of resistance of beams, the strength and fatigue of iron and steel, the strength of columns, and the design of riveted joints. The various rules which have been proposed for fixing the working stresses in the different members of bridges are given, and their justification discussed; the recent failure of two long-span bridges in America emphasises the importance of this subject, and bridge engineers will be hardly likely in future to be any more enamoured of the rules laid down by certain well-known American bridge designers for the working stresses in struts than they have been in the past. The design of arches is very fully dealt with in chapter xiii.; both masonry and metallic arches are treated of, though, as is usual in text-books, much more space is devoted to the latter; this chapter will be one much consulted by the student, who generally finds more difficulty in determining the stresses in metallic arches, and in selecting suitable forms for the different members, than he does when dealing with ordinary trusses; the methods adopted by the author are clear and concise.

This chapter is followed by three which treat of suspension bridges, opening or draw bridges, and traversing or transporter bridges, and then by a chapter full of useful practical details on various types of bridge flooring, piers, and bolsters, or shoes, for distributing the pressure uniformly to the bearing plates. In the last chapter the author has worked out several complete examples of bridge design in order to illustrate the principles he has laid down in the earlier chapters; these examples include timber trestle bridges, highway bridges with steel main girders, a plate girder railway bridge, and, lastly, a Murphy Whipple truss railway bridge of 100-feet span. These examples will be of considerable service to the young designer and to the student.

T. H. B.

Metallic Alloys: their Structure and Constitution. By G. H. Gulliver. Pp. xv+254; illustrated. (London: C. Griffin and Co., Ltd., 1908.) Price 6*s*. net.

THE study of metallic alloys is a "practical" subject. Many alloys were discovered long ago by accident, and the development of their manufacture and use is based on empiricism. Even the recent introduction of a number of other alloys has owed little to theoretical considerations, and no attention is paid to predictions as to the properties of untried combinations. There is plenty of experimental evidence to be classified and discussed, but the time has hardly come for the logical method of treating the subject adopted by Mr. Gulliver. At any rate, the book would have been better balanced if more attention had been paid to the experimental data.

The author has adopted the classification of alloys presented by Roberts-Austen and Stansfield at the Congrès international de Physique in 1900. This classification was based on Roozeboom's study of equilibrium in mixtures, but the author has amplified it in many respects, and with its aid has been enabled to present a tolerably complete theory of alloys on a systematic basis. He has consistently applied the name "solution" to any physical mixture of metals, liquid or solid, and there is doubtless no disadvantage in this way of regarding them, though it has not much claim to be considered as a "method of study." One of the difficulties in applying the solution theory to alloys in practice is that equilibrium is not established in solid mixtures in any reasonable length of time under ordinary conditions. The alloys used in the industries are generally in an unstable state, and when equilibrium has been established in them it often happens that their usefulness has departed. This is, of course, one of the reasons why the recent study of alloys has not thrown more light on their useful properties.

The book, taken by itself, will not be of much use to engineers or manufacturers. It is not even quite what is wanted for students, but it may be recommended to their teachers. The weakest part of the book is that devoted to methods of investigation, which could have been made to afford much more help to those engaged in research. Its greatest claim to be read is that it gives a more complete classification of alloys than has hitherto been available.

(1) *Ex-meridian, Altitude, Azimuth, and Star-finding Tables.* By Lieut.-Commander Armistead Rust, U.S. Navy. Pp. li+393. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 21*s*. net.

(2) *Nautical Charts.* By G. R. Putman, Director of Coast Surveys, Philippine Islands. Pp. viii+162. (Same publishers, 1908.) Price 8*s*. 6*d*. net.

(3) *A Text-book of Theodolite Surveying and Levelling.* By Prof. James Park. Pp. x+216. (London: C. Griffin and Co., Ltd., 1908.) Price 6*s*. net.

(1) THE author has gathered together a very useful set of tables and diagrams for finding the latitude, facilitating the plotting of lines of position, and giving new and practical methods for identifying stars in cloudy weather. The tables extend from lat. 0°–65° and declination 0° 71′ north and south. The book is excellently printed and arranged; full descriptions of how to use the tables are given, together with examples. It should prove most useful to the mariner, as its scope covers practically all the navigable portions of the globe.

(2) This small volume, which deals with the methods of the U.S. Surveying Service, gives a very good general idea of how the work is carried out

from the time of commencing the survey until the chart has been produced ready for issue. It contains good descriptions of the various sorts of charts used by seamen, together with much useful information on how to use them in a proper manner. The book is divided into eight chapters, each one dealing with a separate subject; it is well illustrated, and is a valuable addition to books dealing with hydrographical surveying.

(3) A very useful handbook dealing with general surveying work, levelling, railway curves, and mine surveying; each branch of surveying is well described, and accompanied by diagrams and practical examples collected from actual field experiences. It is a book which should prove as useful to the professional surveyor as to the student. H. C. LOCKYER.

Penrose's Pictorial Annual: a Review of the Graphic Arts. Vol. xiv., 1908–9. *The Process Year Book.* Edited by William Gamble. Pp. viii + 208. (London: A. W. Penrose and Co., Ltd.) Price 5s. net.

In directing our readers' attention to the annual volumes of this publication, we have year by year pointed out the very excellent nature of the contents and the very high state of efficiency which it has attained. So much care has been bestowed on the reproduction methods, the inks employed, and the other materials used that it seemed nearly impossible that any very conspicuous advance could be made except after the lapse of a few years.

Yet in the volume before us we have a proof that such an assumption is incorrect, for one has only to look through the present issue to see how marked the progress made has been since the last volume was issued to the public. Even the editor, in his preliminary remarks, writes:—"We can hardly realise ourselves how it is possible to continue improving on these mechanical processes as has been shown each year, yet here again is the evidence of the possibility, and one is inclined to wonder what further marvels the future has in store for us."

With such a wealth of text and illustration included in this volume it is difficult to name any one feature which is more conspicuous than another. The editor commences, as usual, with his summary of the year's progress in process work, and this is followed by a great number of articles on various branches of the subject by well-known workers. The illustrations, which are, of course, the chief feature of this publication, demonstrate, more than words can do, the excellence of the reproduction processes that are now available. All kinds of subjects are dealt with, from the reproduction of an old master to illustrations for boot catalogues, and these suggest the best kinds of process work for the particular subject to be dealt with.

Perhaps enough has been written to indicate that if anyone wishes to make himself acquainted with the results of process-work of to-day he cannot do better than obtain this handsome and moderately-priced volume. The editor and his co-workers deserve high praise for placing such a useful and valuable publication within easy reach.

The Edinburgh School Atlas. 32 plates. (Edinburgh and London: W. and A. K. Johnston, Ltd., n.d.) Price 1s.

A WIDE popularity may be predicted for this remarkably cheap atlas. The maps are clear, uncrowded, and entirely orographical. There is a good general index showing the latitude and longitude of places included in the maps. It is gratifying to find that geographical publishers are acquainting themselves with modern needs and producing maps which will assist greatly teachers of geography who adopt scientific methods in their work.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Product and Rays of Uranium X.

FROM the present state of the subject it is clear that there is one, at least, and that very probably there are two, intermediate products between uranium X and radium giving α rays on disintegration. The direct parent of radium has recently been shown by Boltwood (*Amer. Journ. Sci.*, 1908, xxv., 377) to give α rays of characteristic range. Between the atomic weight of uranium and radium there is a difference of twelve units, corresponding to the expulsion of three α particles, of which only two, that from uranium and that from the parent of radium, so far are known. It is true there is a disposition to regard it as probable that the change of uranium into uranium X is accompanied by the expulsion of two α particles, as Boltwood (*loc. cit.*, p. 285) has shown that the contribution of uranium in minerals to the total α radiation of the mineral is about twice that of any of the succeeding products.

My recent result on the rate of production of helium from uranium (NATURE, December 3, 1908, p. 129) is against this view. In the thorium series—thorium → mesothorium → radio-thorium → thorium X—complete chemical similarity occurs between the *alternate* pairs—thorium and radio-thorium, meso-thorium and thorium X—no chemical separation of these pairs having yet been found possible. If the hypothetical product of uranium X similarly was chemically analogous to uranium and gave α rays, the result obtained by Boltwood for the α radiation of minerals might perhaps be explained. In the present state of the subject there is hardly sufficient evidence that the number of α particles expelled by uranium is exceptional. Further evidence on the question whether an intermediate body exists between uranium X and the parent of radium may be expected so soon as the uranium preparations we have had for many years under observation in this laboratory begin to grow radium, as the power of the time which the rate of growth follows gives an indication of the number of intermediate stages. Already the results show that if there is not such a body (or bodies) the period of the parent of radium is at least six times as great as that of radium (*Phil. Mag.*, October, 1908, p. 636).

In the meantime I have attempted—so far without complete success—to detect the growth of an α-ray product from very active preparations of uranium X prepared from large quantities of uranium. I have established that there is a feeble residual α radiation remaining from all my uranium X preparations after the β radiation has decayed, and this residual activity *then remains constant*. The residual α activity of a preparation of uranium X some four or five years old has been kept under careful observation for nine months, and no change of activity has been detected. Newer preparations have shown that the α radiation has a practically constant value before the β rays have all decayed, showing that if the α-ray body is a real product of uranium X it must be the *direct* product. The attempt to follow a growth of the feeble α activity simultaneously with the decay of the intense β activity, which the latter view demands should occur, has so far been delayed by the β rays showing unexpected properties. I have not yet succeeded in establishing a genetic connection between the α-ray body and the uranium X, so that all that can at present be said is that the results are not opposed to the view that the direct product of uranium X may give the missing α ray of the series, and prove to be the parent of the parent of radium.

With regard to the β rays of uranium X, these until now have been regarded as homogeneous, with a value for $H\rho$ of 2000; but I have found that in a magnetic field twice as strong as that required to prevent β rays having the value 2000 from entering an electroscope, 5 per cent. of the total effect of the β rays still persists. Even in much stronger fields, using sufficiently active preparations of uranium X, the effect of the β rays is still marked. It

must be mentioned that in a paper just to hand, H. W. Schmidt (*Phys. Zeit.*, 1909, p. 6) gives the new value 4100 for these rays, making the usual assumption, apparently, that they were homogeneous. I obtained the value as high as 6500 for a small proportion of the rays, but no definite extreme upper limit can be assigned, and it is probable that some exist with a value even higher. Some of the β rays of radium possess, so far as I have yet been able to see, values for $H\rho$ above 9000, and probably the extreme upper limit is not reached at 11,000. The extreme value found in Kaufmann's celebrated experiments was 4500, but it must be remembered that he worked with the less sensitive—although more precise—photographic method. For $H\rho$ to have values so high as those recorded the velocity of the rays must be but a small fraction of 1 per cent. below that of light, and their mass must be at least four times in the case of uranium and six times in the case of radium the normal value found at lower speeds. I have had in mind the possibility that the effect might be due to a secondary radiation, and particularly in view of Bragg's theory of the nature of the γ rays, to a secondary radiation from the air; but I have not been able to prove that the rays are other than primary β rays. The direction of their deviation was specifically tested.

FREDERICK SODDY.

Physical Chemistry Laboratory, University of Glasgow.

P.S., *January* 26.—I have omitted to mention that Paschen (*Ann. Phys.*, 1904, xiv., 389) obtained evidence of the existence of β rays from radium with a value for $H\rho$ so high as 8000. F. S.

The Origin of the Aborigines of Tasmania.

IN kindly reviewing my little book on the Discovery and Settlement of Port Mackay, Queensland, in NATURE of September 24, 1908, the reviewer, "J. W. G.," states that Mr. Ling Roth "objects to calling the blackfellows aborigines, as he holds that Australia was first occupied by a negroid people who have been supplanted by the present race. This view, well known from its adoption by [the late] Sir William Flower, appears to be now generally discredited, owing to the lack of evidence in its support."

Since the above was written I have received from Sir William Turner his recently published memoir on the "Craniology, Racial Affinities, and Descent of the Aborigines of Tasmania" (Trans. Roy. Soc. Edin.). In this monograph Sir William Turner comes to the same conclusion as I have regarding the origin of the Tasmanians, arriving there by a totally different and probably more scientific method than that which I have been able to follow. He says (p. 394):—"Though, as has already been stated, a woolly-haired race is not now represented in Australia, the tendency of the South Australians to show Tasmanian characters in the cranial vault is worthy of consideration, in this particular, as an indication of the probable route of migration and of racial affinity. . . . The evidence seems to be in favour of the descent of the Tasmanians from a primitive Negrito stock, which migrated across Australia, rather than by the route of the Melanesian Oceanic islands lying to the north and east of the Australian continent." Linguistic evidence appears also to favour the view. In the December (1908) number of *Man* (p. 185) Father Schmidt ("Classification of Australian Languages") tells us that "the languages of S.E. Australia agree with Tasmanian in one of the most important points—the position of the affixless genitive."

I therefore venture to think that the more the question is studied the more does it seem probable that the real aborigines of Australia were the forefathers of the unhappy people we have known as Tasmanians.

H. LING ROTH.

Halifax, Yorks, December 28, 1908.

MR. LING ROTH's letter involves two questions. The term "native" in Australia means white people born in Australia; the blackfellows are known as aborigines. It seems to me, therefore, only inviting misunderstanding and mistakes to reject the accepted Australian use of the word aborigines in a book dealing with Australia.

The second question is the possible descent of the extinct Tasmanians from the race that occupied Australia before the European colonisation. The very important memoir by Sir William Turner on the craniology of the Tasmanians (Trans. Roy. Soc. Edin., vol. xlvi., pp. 365–403, three plates) was not published at the date of the review; but though he admits the probable passage of the Tasmanians across Australia, he adds to the difficulty of connecting the Tasmanians with the present Australian aborigines.

On pp. 387–8 of his memoir he gives a long list of important characters in which the Australian skulls differ from those of the Tasmanians, and he concludes this catalogue of differences as follows:—"From the consideration of these characters the skulls support the opinion, based on the study by so many observers of the external features, that the existing aborigines of Australia are distinct from the Tasmanians, although the presence, in *a proportion* of the natives of South and West Australia, of skulls in which the height was less than the breadth, the not unfrequent sunk sagittal suture, the more marked parietal eminences, and the antero-posterior parietal depressions, point to a *possible amount of intermixture* and racial affinity of these Australian tribes with the Tasmanians." (The italics are mine.)

That "a proportion" of the aborigines of South Australia should have skulls approximating to those of the Tasmanians is easily explained. Tasmanians were taken to South Australia by the sealers, and gave rise to half-castes. The occasional Victorian aborigines with woolly hair and other Tasmanian features had probably the same origin.

Sir William Turner's memoir may be taken as the final dismissal of Sir William Flower's view that the Tasmanians were Melanesian, and the weight of authority, including Huxley and Mr. Ling Roth, that they were Negrito is now overwhelming; but this adds to the difficulty of alliance between the Tasmanians and the Australians. Sir William Turner says (p. 389), "the term Negrito should be limited to . . . black-skinned, woolly-haired people with small brachycephalic heads, jaws not very projecting, nose not so flattened, nostrils not so wide as in the Negro, and of dwarf-like stature." These characters are not those of the Australian aborigines, with their long, straight hair, hyperdolichocephalic heads, projecting jaws, extraordinarily wide nostrils, and tall stature.

The absence of evidence of the Tasmanian race in the well-searched drifts and gravels of Australia renders their passage across Australia improbable. I am, of course, glad to find that Sir William Turner adds his authority to the view of the Negrito affinity of the Tasmanians, but it does not follow that they crossed the mainland of Australia, a view that has been abandoned by some of those who formerly adopted it.

It would be strange if the Australian and Tasmanian languages had not some points of affinity, but the differences have been usually regarded as fundamental. Mr. Ling Roth has recognised Andamanese affinities in the language of the Tasmanians, which is, of course, consistent with Sir William Turner's conclusions, but it does not help to ally the Tasmanians and Australians.

J. W. G.

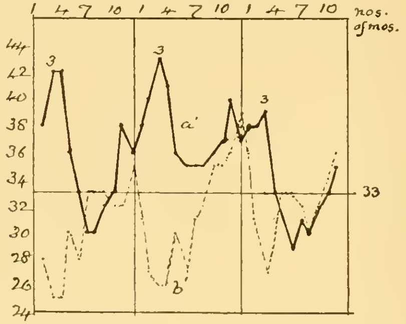
Warm Months in Relation to Sun-spot Numbers.

THE following method, applied to Greenwich data, seems to yield support to the view that sun-spots mean, on the whole, *warmth* in this region.

Taking your sun-spot numbers (from 1841), pick out the 22 highest (group A) and the 22 lowest (group B)—22 is about a third of the series. Next, confining attention to the year after each year of group A, note how many warm Januarys, Februarys, and so on, there were in the 22 years. This gives the series (a) below. Do the same in the case of group B, getting the series (b). Smooth each of these series with sums of 3, getting (a') and (b'). On comparing (a') with (b') the former is found to be throughout in excess of the latter, as shown.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	
(*a*)	11	14	15	14	12	10	13	12	10	14	13	13	= 151
(*b*)	11	8	8	10	8	12	7	12	13	10	12	14	= 125
(*a*′)		40	43	41	36	35	35	35	36	37	40		
(*b*′)		27	26	26	30	27	31	32	35	35	36		
(*a*′):(*b*′)		+13	+17	+15	+6	+8	+4	+3	+1	+2	+4		

The series (*a*′) and (*b*′) are expressed in curve-form in the middle section of the diagram. Note that the (*a*′) curve culminates in the third month (*i.e.* with the 3-month group February–April), and just then the other curve is at its lowest point. The difference here is $43-26=17$ (about 65 per cent. of the lower value).



Curves of total warm months in 3-month groups.

We might extend these curves on either side, considering in one case the temperatures in those years of highest and lowest sun-spot numbers, and in the other those in the second years after.

In both extensions we find, again, the extreme contrast at the third month, but in both, the curves cross each other in part; and in the third section there is general "breakdown," with year-difference small. Thus we have, for totals of warm months:—

	Diff.
Years of (22) highest and (22) lowest sun-spot numbers	$142-123=19$
1st year after	$151-125=26$
2nd ,, ...	$134-130=4$

The sharp contrast above referred to in the early part of the year (February–April) seems to me remarkable, and may be usefully considered in relation to the flowering of plants and other phenological phenomena, the variations in which, from year to year, seem to be connected with the sun-spot cycle (as I have before tried to show).

ALEX. B. MACDOWALL.

RECENT EARTHQUAKES.

THE Italian earthquake still keeps a prominent place in the daily newspapers, and earthquakes still continue in the stricken country, but this is no more than must be expected. Every great earthquake is followed by numerous after-shocks, more frequent at first and gradually becoming fewer and fewer; 949 shocks were registered at Monteleone in 1783, and 150 in 1784. A similar experience is being repeated in Calabria at the present time; reports of more earthquakes at Reggio and Messina are common in the papers, but the record is too incomplete to be worth repeating in detail. Among these after-shocks some have been of sufficient violence to bring down shattered or weakened walls and buildings, and some were of a severity which would have caused serious damage and destruction to buildings had they stood by themselves. The first of these destructive after-shocks seems to have occurred at 7.24 p.m. on January 23, which brought down a good many houses left standing by the earthquake of December 28 at Reggio, and was described as of equal violence. This statement must be accepted with reserve, for experience has shown that after a very great earthquake and during the period when after-shocks are frequent, all sense of proportion is lost, earthquake-fear is developed, and every shock of more than average severity ranks out of proportion to its real importance. Though the shock was apparently a considerable one, and may well have compared in violence with its predecessor at Reggio, yet the much smaller area over which it had the power of inflicting damage, as also the much smaller size of the area over which it was felt, mark it as an altogether minor shock.

Besides the local after-shocks, earthquakes have been reported in the daily papers from other parts of the world, and not unnaturally a connection has been assumed which has probably no foundation in fact. The most important of these were the North American earthquake of January 11, and that in Asia Minor on January 19; the former of these was felt at Victoria, B.C., at 3.55 p.m., local time, and was described as severe; it was also felt at Vancouver and Nanaimo, in British Columbia, and in the Washington State, where some slight damage was done at Port Townsend. The earthquake in Asia Minor seems to have been more severe if not more extensive; it took place at 6.40 a.m. on January 19, and is said to have destroyed 679 houses at Phocœa, two persons are reported to have been killed at Menemen, and the same number at Cassaba. Neither of these was, however, of any importance, and would probably have passed without notice but for the attention directed to earthquakes at the present moment.

Much the same may be said of the shock which shook northern Italy on January 13, though possibly this may have been of the nature of a sympathetic after-shock, that is to say, brought about by a change in the distribution of strains in the earth's crust, consequent on the movements which have taken place in Calabria. It belonged to that little understood class of shocks which affect a large area without anywhere reaching destructive violence, and nowhere did more than trivial damage, though felt at Triest, Trient, Milan, Genoa, Siena, and in all the country between.

In spite of these earthquakes, there is no indication of any real increase in seismic activity; on the other hand, it is a somewhat remarkable fact that the Calabrian earthquake was a solitary one. World-shaking earthquakes almost invariably occur in groups, and are seldom unaccompanied by one or more companions, originating in distant parts of the globe, but within a few hours, or at most a few days, of each other; so frequent is this phenomenon that it has almost been elevated into a law, and an ingenious explanation, with experimental illustration, has been published. In the present instance, the records of Prof. Milne's instruments at Shide show that no other world-shaking shock accompanied the Calabrian one, and none was reported until the morning of January 23, when an earthquake, which probably originated somewhere in western Central Asia, was registered by seismographs in Europe, India, and at the Cape of Good Hope; probably we shall hear more of this earthquake, for its origin was in a region which is not devoid of villages and towns, but the interval which had elapsed prevents our regarding the two earthquakes as companions. This isolation of the Calabrian earthquake may find its explanation in the fact that although a great, it was not a very

great, shock. The extreme diameter of the seismic area did not materially exceed 350 miles, and making every allowance, the area over which the shock might have been felt—including in this the sea—could not have been more than 95,000 square miles; in the Californian earthquake of 1906, the corresponding figure was 372,500, and in the Indian earthquake of 1897 it was 1,750,000. These figures give some idea of the relative magnitude of the three earthquakes, and in the present state of the science it does not seem possible to find a more satisfactory means of comparison.

A point which has attracted notice, and is worthy of attention, is the peculiar weather which accompanied and followed the earthquake. We need not consider the fact that it coincided with the sudden break-up of an equally sudden and severe frost over northern Europe, nor the unusual cold and snowstorms which have followed it in southern Italy. These were due to meteorological conditions of great extent, in all probability unconnected with, and independent of, the earthquake, but the sudden fog which, according to every account, settled on the Straits of Messina stands in a different case. The earthquake in Mexico of January 24, 1898, was similarly followed by a heavy mist, at a time of year when mists are usually unknown, and rainfall is so frequently reported as the immediate successor of an earthquake that we can no longer reject the hypothesis of a real connection between the two. Earthquake weather is a common expression in earthquake countries, but is usually applied to a heavy and oppressive feeling in the air which is supposed to precede an earthquake. Mr. Maxwell Hall has attempted to find an explanation in alterations of the barometric gradient by rapid upheaval of the ground, and has shown that uplifts, which are within the range of possibility, would produce the required effects, but whether there is, or is not, an earthquake weather, in the ordinary sense of the words, there seems reason for believing that in another sense they represent a reality, and that, as has been suggested by Prof. Milne, the disturbance of the ground, when transmitted to the overlying air, may determine precipitation, and explain the apparent association of severe earthquakes with mist and rain. What may be the nature of the influence we know not, but if mechanical, it must be either the result of the vibratory motion of the ground, or else of permanent changes of level, accompanied by the sudden upheaval or depression of the overlying column of air, and of this permanent change of level we are still without any satisfactory evidence. In the accounts which have reached us, quays and pierheads are mentioned as having subsided beneath the water, but there is nothing to show that more than a settlement of made ground has taken place, while the photographs which have been published suggest that this rather than any displacement of the solid ground is the explanation of the apparent subsidence, and the commission appointed to inquire into the changes which have taken place in the harbour of Messina has reported that though the quays have been destroyed in places, no permanent change has taken place which will interfere with the continuation of its use as a port.

R. D. O.

GRAVITATIONAL THEORIES.

IT is well known how cultivators of physical science in Great Britain lag behind the most up-to-date philosophical views in continuing to think that valuable light is thrown on physical phenomena by the elaboration and study of mechanical analogies of more familiar type, and more readily grasped by the mind. These matters are, perhaps unfortunately, for us largely the affair of specialists in science, who understand both the value and the limitation of the method.

For example, in the days of the very instructive—and somewhat insular—mathematical development of Lord Kelvin's idea of vortex atoms, the mechanical analogies of gravitation were much to the fore; and in particular Prof. W. M. Hicks elaborated, a quarter of a century ago (*e.g.* in *Camb. Phil. Soc. Proc.*, October, 1879), on the basis of experiments by Guthrie and others, a beautiful theory of how the attractions of gravitation could be imitated by pulsating bodies in a liquid medium. Further developments, theoretical and experimental, of interesting character, with relation also to electrodynamics, were made in the well known experiments of Bjerknes. Indeed, some such notion is the only simple direct mode of imitating gravitation which has presented itself; there is the alternative, of course, that it may be a residual of other more potent actions.

In this regard, the pulsation analogy lies at the back of the heads of most people interested in the subject. But lest we forget, the watchful enterprise of the daily Press in reporting by special correspondence from Berlin the recent exciting revival of these ideas illustrates one of the ways in which it can keep us in touch with the latest developments of science. Doubtless the experimental phenomena reported with so much emphasis will be found eventually to contain much that is interesting and useful as new aspects of this well-worn subject.

MOUNTAINEERING IN NORTHERN NORWAY.[1]

THERE being little left in Switzerland for the mountaineering pioneer, climbers who prefer exploration to gymnastics have been driven further afield. Mrs. le Blond (then Mrs. Fred Burnaby) was one of the leaders in Swiss winter climbing; but after fifteen seasons in the Alps she was induced to visit northern Norway, partly from the desire for virgin peaks and partly to give her well-known guide, Imboden of St. Nicholas, a change of scene after the death of his son on the Lyskamm. This volume records the story of five seasons' climbing amongst the glaciers and peaks of northern Norway near Tromso. The narrative is pleasantly and modestly written, and is occupied by short accounts of the author's twenty-seven first ascents in this district. The country has many advantages over Switzerland; it has the charms of solitude, of freedom, and of being imperfectly mapped and explored; until recently its peaks were unclimbed, and many of them even unnamed.

Mountaineering in northern Norway is free from two Alpine risks. No one can be benighted in this land of continuous daylight, and there is no danger from exposure to cold in the mild climate, repeatedly attributed by Mrs. le Blond to the Gulf Stream, in which her faith is firm and primitive. The country has, however, the drawbacks of long spells of bad weather. On one occasion, for example, two friends arrived at Mrs. le Blond's camp for a few weeks' climbing at the beginning of "five weeks of the very worst weather I have ever seen" (p. 179). The constant mists and clouds add greatly to the picturesqueness of the country, and to them are due the beauty of many of Mrs. le Blond's photographs; but fogs and continual rain may easily prevent any mountaineering except to those who have most of

[1] "Mountaineering in the Land of the Midnight Sun." By Mrs. Aubrey le Blond. Pp. xii+304; map and 71 illustrations. (London: T. Fisher Unwin, 1908.) Price 10s. 6d. net.

the season at their disposal. The mosquitoes do their best to render life intolerable, but Mrs. le Blond found them of no trouble except in the valley; the writer, however, remembers one easy rock-climb in an area to the south of Mrs. le Blond's district that became dangerous owing to a flight of mosquitoes, which took advantage of the shelter from the wind to accompany him up the cliff.

The extreme rottenness of the rocks renders the danger of falling stones greater than in Switzerland. The mountains are covered with such a litter of loose stones that, according to the author, it is unsafe for more than three climbers to go on a rope. "Dumkopf! you will have the whole mountain down," is one of Imboden's ejaculations to his son. Mrs. le Blond seems disposed to attribute the superior security of the Alpine rocks to successive climbers having cleared away the loose material. Her testimony throughout the book to the looseness of the rocks, and the photographs showing the sharp cones and jagged pinnacles characteristic of the country, suggest that only the lower slopes of the mountains have been glaciated. She speaks of well-rounded glaciated surfaces on the lower ground, and it appears possible, from her descriptions and photographs, that, as has long been well known regarding the Lofoden Islands, the mountains were never completely buried beneath an ice-sheet. Their upper slopes may still wear the débris due to pre-Glacial weathering.

The book gives very little direct geographical information other than details as to the climbing. To mountaineers in the Tromso district it will be indispensable. There is a short chapter on the Lapps, and much enthusiasm expressed for both Norway and the people. One of the most valuable features in the book is its fine series of photographs; the 304 pages of the text are illustrated by seventy photographs, nearly all of which occupy a full page, and the illustrations give an excellent idea of the geographical structure of the country. Some of them confirm the view that this part of Norway is a dissected plateau. The book has, unfortunately, no index and practically no map, for its useless chart of Scandinavia and the Baltic merely indicates the position of the district in which Mrs. le Blond's mountaineering feats were achieved.

J. W. G.

The Urtind at Midnight. In the background the Faestning and Kjostind. From "Mountaineering in the Land of the Midnight Sun."

A NATIONAL SCHEME OF AFFORESTATION.

THE Royal Commission on Coast Erosion and Afforestation has issued its second report, which deals with afforestation. If the scheme proposed in this report be adopted, it would mean that in eighty years from its commencement there would be afforested 9,000,000 acres of land at present classed in the agricultural returns as rough mountain land used for grazing. In their investigations the commissioners find that there are no less than 16,000,000 acres not under cultivation or permanent pasture in Great Britain. To this there may be added several million acres of similar land in Ireland. However, much of this land is not suitable even for tree-growth, and may be already used to better advantage. The commissioners find 9,000,000 acres of this land is suitable for afforestation, and they recommend that the State should undertake the task of afforesting that area.

Two schemes, a larger one and a smaller one, are proposed:—First, that the maximum area—9,000,000 acres—should be planted up at the rate of 150,000

acres annually for sixty years, a third of this area to be worked on a forty years' rotation, and two-thirds on an eighty years' rotation. The value of the property in possession of the State at the end of the rotation would be 562,075,000*l*., or 106,993,000*l*. in excess of the sum involved in its creation, and, allowing 3 per cent. compound interest on the initial capital expended, the annual revenue would be 17,411,000*l*. Secondly, the smaller scheme provides for the afforestation of 6,000,000 acres to be planted at the rate of 75,000 acres annually for eighty years. The value of the property at the end of that time would be 320,000,000*l*., or 60,944,000*l*. in excess of the cost of production, and would yield henceforth an annual return of 10,000,000*l*.

These figures, it should be mentioned, are based on average estimates of the cost of freehold and planting, as well as the returns from thinnings and final fellings. The experts and witnesses examined by the commission were unanimous in their opinion that the soil and climate of Britain are eminently well suited for the growth of trees and forests. That a shortage exists in the world's supply of timber is a fact which every day makes more apparent. The evidence placed before the commissioners shows that within the last decade the price of timber has increased 30 to 50 per cent., while the quality has decreased. No doubt many substitutes have been invented, but this has not decreased the consumption of timber, and in spite of those many substitutes there are indications that the consumption of timber is increasing. Mention is made in the report of many places where afforestation has been properly conducted in this country, and has yielded handsome returns on the outlay. For this and many other reasons too numerous to quote, the commissioners are satisfied that "with due regard to sound principles and economic management, timber-growing has in this country proved profitable," and that "success in the future with improved methods should be generally assured."

So far, the report thus shows that at present a vast area of what should be valuable productive land in this country is lying practically unproductive, and, if afforestation were started on the lines of the scheme proposed, this land would give employment to 18,000 labourers during the planting season. But forestry on such a large scale is bound to improve and encourage subsidiary industries, and even give rise to new ones which depend upon timber for their raw material. These industries, it is estimated, would absorb an amount of labour equal to that of one man for every eighteen acres of forest, while evidence has been placed before the commissioners that such land as is at present utilised provides employment for one man on 1000 to 2000 acres. This naturally opens up the question as to the possibility of providing work for the unemployed.

The commissioners have made exhaustive inquiries in this direction, and find that for certain kinds of labour involved in afforestation the unemployed have been used with satisfactory results. There is no doubt that the requisite number of labourers could be obtained from the ranks of the unemployed. A great deal depends, however, upon the physical fitness of the labourers so obtained. The commissioners believe that, with a judicious selection and probably a short period of training, many of the unemployed would be quite capable of engaging in the work of planting. It is a difficult question to decide whether the unemployed are suitable for such work. In this connection two problems are involved, viz. provision for the maintenance of our future timber supplies, and the relief of the unemployed. Undoubtedly the present needs of the unemployed are urgent, but the maintenance of our future timber supplies is equally important, and although the present generation sees the distress caused by unemployment, this would become worse in the next generation should our timber supplies run short.

The whole success of afforestation depends upon the skill and care with which the forests are established. To dig a hole and plant a tree may seem quite simple, but it nevertheless requires a considerable amount of skill. Bad planting has been the ruination in many cases of what should have been at present fine forests. If the unemployed are to be utilised at all, they would have to be subject to a considerable amount of supervision by skilled, practical foresters, and it is not very clear from the report how these trained foresters are to be procured. No doubt there are a good many such men in the country at the present time, but not sufficient to supervise the work of afforestation on such a scale as the commissioners propose. Manual labour is no doubt essential, but the success of the future forests will depend upon the skill with which such labour is directed towards the achievement of the object in view. It must also be kept in mind that a general survey of the country is necessary as a preliminary operation in order that the areas suitable for afforestation may be mapped out and located. After this work would naturally come a detailed survey of the different areas to determine many essential and important matters, such as the suitability of the area for the growth of certain trees, and the preparation of working plans or schemes of management. This work could only be entrusted to well-trained experts. It must be remembered that initial mistakes in sylviculture are not only difficult to remedy, but that their effects last over a long series of years—possibly a whole rotation.

In estimating the expense of carrying out a scheme such as they propose, the commissioners seem to have made very little provision for the maintenance of a properly trained forest staff apart from those engaged in manual labour. Although it is quite certain that our soil and climate are capable of producing high-class timber, still we have yet a great deal to learn about sylviculture in this country. Comparisons with Germany are useful, but even in Germany local conditions have to be studied, and suitable systems of sylviculture and management adopted.

In their report the commissioners state that they have been reminded that "on the Continent large areas of woodland are periodically overrun by destructive insects, whose depredations entail large loss, whereas the most troublesome of these pests are practically unknown in this country." This is very optimistic. We have already a fair share of those insect pests, and, should we ever have large areas of woodlands like the Germans, there is very little doubt but that we shall also have the insects and other attendant evils, such as fungi. These, however, could be kept in check provided proper scientific protective measures are adopted in time.

On p. 41 of the report it is stated that "the afforestation of suitable lands in the United Kingdom, if undertaken on an adequate scale and in accordance with well-recognised scientific principles, should prove at present prices a sound and remunerative investment." It is suggested that, if Parliament should determine to carry out the recommendations proposed, the scheme should be administered by commissioners specially appointed for that purpose. But between those administrators and the working staff comes a gap which can only be filled by the man who knows.

The commissioners, it seems, have not taken this part of the staff into account in drawing up their estimates of working expenses. The forest schools at present in existence in this country, with a little development, would be quite capable of undertaking the scientific training of this very essential part of the staff. For many years past the pressing need for demonstration areas and forest gardens has been urged upon the Government. Had these institutions been in existence now, their value would have been inestimable in indicating the soundest and most economic lines upon which extended afforestation should be carried out.

Coming now to the question of the acquisition of the necessary land, the commissioners recommend that compulsory powers be obtained by legislative enactment whereby proprietors would be forced to sell suitable land should private negotiations fall through. However, certain alternative schemes are proposed. For example, a scheme suggested by Lord Lovat of co-partnership between the private owner of land and the State, the owner to provide the land free of cost, the State to provide the capital necessary for its afforestation, the profits to be shared *pro rata* of their respective contributions, the owner to have the option at any time of buying out the State's interest. Again, it is suggested that the commissioners might be given power to afforest land acquired otherwise than by purchase by special arrangement with the owner, on such terms and conditions as may be approved by the Treasury, provided due security be taken for the continuity of the scheme. Still another plan is suggested, viz. that, if the owner of a surveyed area is prepared to afforest his land in a reasonable time under the supervision, and to the satisfaction, of the Forest Commissioners, compulsory powers of purchase should not be enforced against him. Finally, the commissioners suggest that the existing facilities given to landowners for obtaining loans for planting might perhaps with advantage be increased by extending the time for the repayment of the loan.

There are weighty reasons in favour of these alternative suggestions. In the first place, it would ensure the important cooperation and active assistance of landowners, many of whom are at present engaged in renewing and extending their forest areas, while many others would be willing to do the same should forestry become an established industry. The compulsory acquisition of the necessary areas would be bound to lead to a breaking-up of the existing arrangement of the land, especially as regards the larger sheep farms, and the consequent diminution of the food supplies, especially mutton, would possibly be greater than the 4·81 per cent. at present anticipated. By encouraging private owners to extend their forest areas, and by the gradual purchase of suitable land where available, the State would more slowly, but at the same time with greater certainty, attain the object which the commissioners have in view.[1] Legislative enactment might be directed towards the adjustment of the present railway rates, and the abolition of the tax on afforested areas.

In discussing the cost of plants and planting, the statement made at the top of p. 26, namely, that "if plants are purchased they will probably cost 4*l.* to 5*l.* per acre," does not seem to tally with the evidence, or what immediately follows in the next paragraph.

[1] It would also entail less initial expenditure. Under the present scheme it is proposed to raise the necessary capital by loan, the interest to be defrayed out of taxation. For the full scheme 2,000,000*l.* would be required annually. The net deficit in the first year would be 90,000*l.*, which would increase to 3,131,250*l.* in the fortieth year, after which it is calculated the forest would have become self-supporting.

DR. FRANCIS ELGAR, LL.D., F.R.S.

THE sudden death of Dr. Francis Elgar, F.R.S., at Monte Carlo, on January 16, has deprived the profession of naval architecture of one of its most eminent representatives, and the loss will be felt throughout the world of science, in which he had made many friends. He came of a family which had for generations been connected with the great naval arsenal at Portsmouth, and was himself apprenticed there about fifty years ago. For nearly seventy years the Admiralty has maintained an admirable system of schools for its apprentices, and has provided facilities by which those who prove capable of benefiting thereby shall receive higher instruction in those branches of mathematics which are used in connection with shipbuilding, as well as in the operations and processes incidental to practical work in drawing offices and mould lofts. Elgar was one of the young men whose progress in the school secured advancement to higher instruction. Fortunately for his career, just at the period (in 1864) when he had completed the preliminary stages of training at Portsmouth, it was decided by the Admiralty and Science and Art Department to join forces and to establish the Royal School of Naval Architecture and Marine Engineering at South Kensington. The Admiralty students at this school were selected by competitive examination in which apprentices in all the Royal dockyards took part. Elgar was one of eight young men chosen in this way from a very large number of candidates, and given an opportunity of passing through a three years' course of advanced study in the theory and practice of shipbuilding. This he did with distinction, and was awarded a first-class diploma of Fellow of the Royal School of Naval Architecture in 1867.

Sir Edward Reed—then chief constructor of the navy, and himself a graduate of an earlier school of naval architecture—took a warm interest in the welfare of the graduates from the new school, and appointed Elgar an assistant overseer of the ill-fated turret ship *Captain*, which was then building by Messrs. Laird, of Birkenhead. In the preparation of the design for that vessel, Captain Cowper Coles, R.N., had collaborated with Messrs. Laird, and Admiralty inspection was limited to supervising the work of construction. In this manner Elgar at an early age supplemented practical training obtained in Royal dockyards by close association with the business of a great private shipyard. About two years later he was recalled to Portsmouth, and received an appointment as a shipbuilding officer, being employed on important practical work in that establishment when the loss of the *Captain* took place. The master shipwright of the dockyard was asked to give evidence before the court martial in regard to the stability of the *Captain*. These conditions were altogether exceptional owing to the extremely low freeboard and heavy sail equipment of that vessel. In the preparation of this evidence, Elgar gave considerable assistance to his superior officer, and in this way began a series of investigations into the stability of ships which extended over many years, and covered mercantile vessels of various types, as well as warships.

In 1870 Sir Edward Reed resigned his position in the Admiralty, and established a private practice in London. Elgar became his chief professional assistant in 1871, and took charge of the London office, in which, during the next few years, novel and important designs for foreign warships and for mercantile vessels were prepared. In all these designs, as well as in the supervision of the work of building the ships, Elgar took an important part, and his services were acknowledged by Sir Edward Reed.

From 1874 to 1876 Dr. Elgar occupied an important position as general manager of Earle's Shipbuilding Company, at Hull; and from 1876 to 1879 practised in London as a consulting naval architect in conjunction with Sir Edward Reed.

A close connection with the Japanese Government, for whom Sir Edward Reed had designed several warships, led to the appointment of Elgar, in 1879, to be their special adviser upon naval construction. He proceeded to Japan, and remained there for about two years, dealing with important questions relating to dockyard organisation and shipbuilding programmes. This appointment indicated the high reputation Elgar had already achieved. On his return from this period of foreign residence, Elgar practised as a consulting naval architect in London, and continued to act in that capacity until 1886. For the most part his work was of a private character, but it included service as the confidential adviser of leading steamship companies, and was marked by public appearances in connection with special investigations into the causes of accidents to, or the loss of, important vessels. When the Orient liner *Austral* foundered in Sydney Harbour, Elgar investigated the matter, and demonstrated that the accident was due to a lack of proper precaution during the process of coaling the ship. When the *Daphne* capsized while being launched on the Clyde, Elgar exhaustively investigated the circumstances, and gave a rational explanation of the disaster. He also served as a member of the Special Committee appointed by the Board of Trade in 1883—with Sir Edward Reed as chairman—to propose rules for fixing the load-line of merchant vessels. The work done by this committee included the consideration of the strength and stability of many types of ships, furnished a settlement of a most difficult question, is still bearing fruit, and promises to lead to an international agreement.

During this period of his career, Elgar was appointed the first university professor of naval architecture in Great Britain. This chair was established at Glasgow (in 1883) by the munificence of Mrs. John Elder, and the selection of Elgar to fill it gave universal satisfaction, and afforded fresh evidence of his high professional reputation. The inaugural address which he delivered at the commencement of his work not merely attracted a large and representative audience, but was in itself a most excellent performance. The period during which Elgar served as a teacher of naval architecture was comparatively brief, for early in 1886 the Admiralty created the new post of director of dockyards, and sought out a man to fill it who should combine experience in private yards with an intimate knowledge of warship-building. Elgar was selected, and accepted the great responsibility of making proposals for reorganisation of the dockyards and giving practical effect thereto, with the view of increased economy and rapidity in the work of construction and repair of the ships of the Royal Navy. This was no light task; it was well performed, and voluntarily terminated in 1892, when Elgar accepted an invitation to become a director and consulting naval architect to the Fairfield Shipbuilding and Engineering Company, of Glasgow. This business had been first established by John Elder and others, had been greatly developed by Sir William Pearce, and after his death was in need of a capable and thoroughly trained professional head. The connection which thus began was terminated by his own choice about two years ago, with the intention to obtain and enjoy a well-earned leisure. From this retirement, however, he soon emerged in order to undertake the chairmanship of the great industrial enterprises belonging to Cammell, Laird and Co., including steel works, armour-plate factories, shipbuilding and marine engineering departments, and mining operations. Immediately after accepting this position it was associated with that of chairman of the Fairfield Shipbuilding Company. When Elgar assumed these responsibilities, a radical reorganisation had to be undertaken in the establishments and staffs of Cammell, Laird and Co. In carrying out this heavy and delicate task, Elgar gave remarkable proofs of ability and energy, and necessarily made demands upon his strength which may have tended to bring about the unexpected and sudden death so widely mourned. He had taken a holiday on the Riviera at the close of the year; a slight accident occurred, but there was no thought of consequent danger, and the end came suddenly.

Elgar united practical experience with a wide knowledge of science and strong literary tastes. His papers on professional subjects—most of which are published in the Transactions of the Royal Society, and in those of the Institution of Naval Architects—furnish illustrations of these qualities, and contain much original work. About two years ago Elgar undertook the delivery of the Forrest lecture at the Institution of Civil Engineers, and dealt with "Unsolved Problems in Naval Architecture" in a manner which excited admiration amongst those familiar with ship design, while it proved interesting to engineers generally. He was elected F.R.S. in 1895, and some years previously had become F.R.S.E. The University of Glasgow gave him the honorary degree of LL.D. in 1885. His closest connection was naturally with the Institution of Naval Architects, on the council of which he had served for twenty-five years, and of which he was treasurer and honorary vice-president at the time of his death. He was a member of council of both the Institution of Civil Engineers and the Royal Society of Arts, in the affairs of which he took an active interest. He was also a member of many engineering and scientific societies at home and abroad. The council of the Institution of Naval Architects chose him to act as their representative on the governing body of the Imperial College of Science and Technology, on the committee of the National Physical Laboratory, and on the Advisory Committee on Shipping established recently by the Board of Trade.

Elgar did good work in connection with the British commissions for international exhibitions at Chicago, Paris, and elsewhere, and his services were recognised by his appointment as Chevalier of the Legion of Honour. His last work in this department was done for the Franco-British Exhibition, where he served as chairman of the shipbuilding section, and organised one of the most remarkable collections of ship-models ever brought together. Busily engaged as he always was, Elgar had little opportunity for extensive literary work. In 1873 he produced an interesting and beautifully illustrated book on "The Ships of the Navy," and in various papers—some of which were contributed to the "Sette of Odd Volumes"—he displayed an intimate knowledge of the earlier history of shipbuilding. He was intimately concerned also with the production of the review, *Naval Science*, founded by Sir Edward Reed in 1872, and continued until 1875. Elgar was a man whose interests were wide and varied; his personal qualities secured for him a multitude of friends who mourn his loss; but, above all, he will be remembered as a brilliant example of the modern naval architect in whose work were embodied the results of thorough training in both the science and practice of his profession, which training was supplemented by ripe and varied experience, and bore fruit in original investigation, the solution of novel and difficult problems, and valuable contributions to the development of a great British industry.

W. H. WHITE.

NOTES.

THERE is a sign that some interest is being shown by Court officials in scientific matters, for the Court Circular announced on January 20 that an "Empire clock" had been brought under the notice of the King and its mechanism explained. The invention which has been afforded this honour is a terrestrial globe kept in rotation by clockwork. A fixed ring parallel to the equator has time divisions marked upon it, and as the globe rotates the position of any meridian with reference to this ring enables the time to be seen. Judging from the prominence given to this clock, it would seem that the King's household and writers in the daily Press marvel that it should be possible to show the effects of the diurnal motion of the earth by means of a model driven by clockwork, or to represent the change of declination of the sun by a gilded ball sliding on a wire. To anyone familiar with astronomical models the device would scarcely appear worthy of being brought under the King's attention. Perhaps we shall next see the announcement by the Court newsman that someone has had the honour of demonstrating a method of proving the principle of Archimedes. A beginning having been made, we may look forward to the time when apparatus really of scientific importance will be regarded with the interest given to a clockwork globe.

A STRIKING instance of the assistance which can be rendered by wireless telegraphy in overcoming the difficulties and dangers of navigation was afforded in the case of the collision of the steamship *Florida* with the White Star liner *Republic* in the early morning of January 23. The collision occurred in a dense fog at 5.30 a.m., 175 miles east of the Ambrose lightship, New York. The *Republic* is equipped with a wireless telegraphy installation, and the captain, who was on the bridge at the time of the accident, at once had wireless messages for help sent out. The operator was Mr. J. Binns, and he remained at his post until help was received. The messages were received by the liners *Baltic*, the *Lorraine*, and the *Lucania*, the nearest of these being some 100 miles away. The steamships proceeding to the rescue were able to transmit a wireless message to the *Republic* asking for the latitude and longitude of the collision, which was answered from the *Republic* as being 40° 17′ N. and 70° 26′ W. Wireless telegraphy has thus been the means of averting a terrible calamity. It also enabled the responsible authorities at New York to get into communication with the ships, to learn promptly the exact state of things, and to issue any necessary instructions.

THE inoculation of soils intended to carry leguminous crops with the appropriate organism for fixing nitrogen has recently been the subject of several letters in the *Times*. It was pointed out in these columns a year ago (February 6, 1908, vol. lxxvii, p. 330) that the experiments quoted in favour of these particular cultures really prove nothing. Since then extensive trials have been made at the Royal Horticultural Society's Gardens, Wisley, and gave entirely negative results. We know of no properly conducted experiments with these cultures that have given definite positive results; the evidence adduced in Messrs. Carter's letter is of the same kind as that given in the original pamphlet, and cannot be regarded as throwing fresh light on the subject. It is distinctly unfortunate for soil bacteriology that a process should be recommended for adoption on the practical scale when it is as yet only in the laboratory stages.

THE seventeenth Deutscher Geographentag will meet at Whitsuntide (June 1–3) in Lübeck. Communications intended for the meeting should be sent before March 1 to the secretary of the association, Königstrasse 5, Lübeck.

UPON the recommendation of a joint committee of the Royal Society of Arts and the Royal College of Physicians, the Swiney prize has been awarded to Dr. C. A. Mercier, for his work on "Criminal Responsibility." The prize is a cup of the value of 100*l.* and money to the same amount.

THE death is reported of Dr. C. Denison, of Denver, Colorado, a specialist in the problems of tuberculosis, particularly in their relation to climatic conditions. He was professor emeritus of diseases of the chest in the University of Denver. In 1890 he was president of the American Climatological Association.

IT is reported that Monte Cagua, a volcano situated in the Tayabas province, in the south-western part of the island of Luzon, Philippines, became suddenly active on January 19, breaking out into a violent eruption and doing serious damage to the surrounding country. During the eruption streams of lava are stated to have rushed down the sides of the volcano.

A GERMAN mineralogical association has been inaugurated, says the *Revue scientifique*. Prof. Max Bauer, of Marburg University, has been elected president, and Prof. F. Berwerth, of the University of Vienna, and Prof. R. Brauns, of the University of Bonn, vice-presidents. It is said that the first general meeting of the association will be held at Salzburg on September 18 next.

WE learn from the *Lancet* that the efforts of the Grecian League against malaria have had wonderful results in the plain of Marathon, which used to be a hotbed of fever. In 1906, 90 per cent. of the cases of sickness were due to malaria. In 1907, after the first efforts of the league, the malaria cases fell to 47 per cent. of all cases of sickness. During last summer, however, usually the most intensely malarious season, the sickness due to malaria fell to only 2 per cent. of the total amount of sickness at Marathon.

ON Tuesday next, February 2, Prof. A. A. Macdonell will begin a course of three lectures at the Royal Institution on "The Architectural and Sculptural Antiquities of India." During the course the Buddhist, Hindu, and Mohammedan antiquities will be dealt with, and illustrated with lantern-slides. The Friday evening discourse on February 5 will be delivered by Prof. J. G. Frazer, on "The Influence of Superstition on the Growth of Institutions," and on February 12 by Prof. H. A. Wilson, on "The Electrical Properties of Flame." The discourse on February 26 will be delivered by Prof. H. L. Callendar, on "Osmotic Phenomena," instead of by the Earl of Berkeley.

AT the annual meeting of the Entomological Society held on January 20 the following officers and council were elected for the session 1909–10:—*President*, Dr. F. A. Dixey; *treasurer*, Mr. A. H. Jones; *librarian*, Mr. G. C. Champion; *secretaries*, Mr. H. Rowland-Brown and Commander J. J. Walker, R.N.; *other members of the council*, Dr. T. A. Chapman, Mr. A. Harrison, Mr. Selwyn Image, Dr. K. Jordan, Dr. G. B. Longstaff, Mr. H. Main, Mr. G. A. K. Marshall, Prof. E. B. Poulton, F.R.S., Mr. R. Shelford, Mr. Rowland E. Turner, Mr. J. W. Tutt, and Mr. C. O. Waterhouse.

A REUTER message from Stockholm states that on January 22 Dr. Sven Hedin delivered a lecture upon his travels in Central Asia before a large audience, which included King Gustav and the Royal Family, and the

members of the Anthropological and Geographical Societies. The Wahlburg medal of the latter society has been conferred on Dr. Sven Hedin, and the society has raised a fund of 10,000 kroner (about 555*l.*), to be known by the explorer's name, which will be devoted to purposes of geographical research.

THE following are the names of officers and council elected at the annual meeting of the Royal Meteorological Society on January 20:—*President*, Dr. H. Mellish; *Vice-Presidents*, Mr. W. W. Bryant, Mr. W. H. Dines, F.R.S., Commander M. W. C. Hepworth, C.B., Dr. H. R. Mill; *Treasurer*, Dr. C. T. Williams; *Secretaries*, Mr. F. C. Bayard, Commander W. F. Caborne, C.B.; *Foreign Secretary*, Dr. R. H. Scott, F.R.S.; *Council*, Messrs. R. Bentley, F. J. Brodie, C. J. P. Cave, Dr. H. N. Dickson, F. Druce, E. Gold, R. Inwards, B. Latham, R. G. K. Lempfert, Colonel H. E. Rawson, C.B., Captain R. C. Warden, Captain D. Wilson-Barker.

AN Imperial International Exhibition is to be held this year on the site occupied by the Franco-British Exhibition of 1908. The exhibition will be opened early in May, and close in October. We notice that the general committee includes a generous proportion of well-known men of science, and that prominence is to be given in the exhibition to science and technology. Among the groups of exhibits to be arranged will be collections representing education, mechanical and civil engineering, agriculture, mines and metallurgy, and chemical and electrical industries. Judging from the detailed subheadings under which the exhibits are to be arranged, the exhibition, as a whole, will serve to illustrate recent progress of applied science in various countries.

THE International Waterways Treaty, which was under discussion in the United States Senate last week, is the outcome of the International Waterways Commission, consisting of three representatives from the United States and three from Canada, which was appointed four years ago. Among the objects which the treaty has in view is the preservation of the levels of all the international waters in the North American continent—a matter of vast importance to the peoples of both countries, and, in the case of the river Niagara, to the whole world. According to the Ottawa correspondent of the *Times*, the two countries are entitled to the water in equal proportion, but if the United States were to take a quantity similar to that taken by Canada, unquestionably the beauty of the American falls would be spoiled and, perhaps, entirely destroyed. One mile above the Niagara Falls the water flows evenly between the two countries, but as it approaches the crest of the falls the current swings over towards the Canadian side. The Waterways Commission recommended that the limit of Canada's rights should not exceed 36,000 feet per second, and, in order to preserve the American falls, a limit was suggested of 18,500 cubic feet per second for the United States. The latter provision has been increased by the new treaty to 20,000 feet, as experiments made last summer demonstrated that the effect of the diversion of water on the American falls was less than had been anticipated. Canada receives 16,000 feet more than her neighbour, and this will enable the three companies on the Ontario side to develop 425,000 horse-power, as against 236,000 on the New York side. By the new treaty neither country can take any action which will lower the levels of the waters of the Great Lakes without the consent of the commission. In the opinion of competent authorities, the diversion of 20,000 feet per second for the Chicago Drainage Canal, which has been proposed, will affect the levels of Lake Michigan, Lake Huron, Lake Erie, Lake Ontario, and the St. Lawrence River seriously. It is not likely that the commission will authorise the diversion of so large a quantity of water.

A MOVEMENT has been set on foot by the English Ceramic Society for a conference of representatives of the various technical institutes and societies to consider ways and means of arranging for the "grading" and standardising, so far as possible, of the refractory materials, such as fire-clay, magnesite, &c., used in the construction of furnaces, kilns, ovens, &c. Representatives of various institutes of societies met at Stoke-on-Trent on January 4 and formed themselves into a committee for the standardisation of refractory materials. The general opinion of the representatives present was that there is need for such a committee, and that the following preliminary scheme should be adopted:—(*a*) to arrange and classify the various refractory materials—clay; siliceous, as silica and gannister; special, as magnesite, chromite, &c.; (*b*) to arrange standard specifications for the raw materials and for the manufactured products; (*c*) to consider the possibility of arranging for uniformity in certain "stock" or "standard" sizes; (*d*) standard methods of testing, analysis, &c. To carry out this scheme, it was agreed that the representatives of the institutes should consult with their respective fellow members, and wherever possible procure information bearing on their specific requirements, together with data as to furnace temperatures and conditions of operation. There is no doubt that the work undertaken by the committee is important. The methods in vogue for the investigation of clays have so advanced in recent years that this subject can now be treated in a manner which would have been impossible five or six years ago. It is to be hoped that all consumers of refractory materials will communicate their views on the matter either to the secretaries of the different institutes and societies or direct to the general secretary, Dr. J. W. Mellor, English Ceramic Society, Stoke-on-Trent.

THE life and works of Thomas Pennant (1726–98) form the subject of this month's contribution to the biographies of early British ornithologists in Witherby's *British Birds*. Few persons other than professed naturalists are probably aware of the number of works which flowed from the pen of this voluminous writer, not many of which are, however, now consulted. The memoir is illustrated by a reproduction of the portrait by Gainsborough.

THE retirement of Mr. Montagu Browne from the post of curator has furnished the authorities of the Leicester Museum and Art Gallery with a favourable opportunity of reviewing, and when necessary modifying, the arrangement and scope of the natural history exhibits. According to the sixteenth report, dealing with the period from April 1, 1905, to March 31, 1908, it has been decided to display collections forming a complete record of the natural history, geology, and antiquarian ethnography of the district. In addition to this, as may be justifiable in a city so large as and so distant from the metropolis as Leicester, general collections in certain groups are to be exhibited. In future the reports will be issued and published annually.

TWO papers on the mammalian brain appear in the January number of the *Journal of Anatomy and Physiology*. In the first of these Prof. Peter Thompson gives a description of a model of the brain of a fœtal cat 20 millimetres in length, while in the second Dr. E. H. J. Schuster continues his elaborate and richly illustrated

account of three Chinese brains in the museum of the Royal College of Surgeons. Special interest attaches to the model of the kitten's brain on account of the fact that very few such models illustrating the early stages of mammalian cerebral development have hitherto been prepared. It is noteworthy that this brain presents a striking resemblance to that of the human fœtus at the third month.

WE are indebted to Prof. T. D. A. Cockerell for certain desirable corrections in a note published in NATURE for November 12, 1908, on his article in the *American Naturalist* for September of the same year on the Miocene fresh-water beds of Florissant, Colorado. He points out that it is the genus Trichophanes, and not the Florissant representative thereof, that was first described from Nevada. Also, it is the existing genus Percopsis, and not Trichophanes (which is solely Miocene), that lived in open glacial water during the Florissant period. In place of expressing a definite opinion on the bearing of the Florissant fauna and flora on the problem of a former connection between the southern continents, the author leaves the question open. We may take this opportunity of mentioning that a case containing a representative series of the Florissant fossils was recently placed on exhibition in the reptile gallery of the geological department of the Natural History Museum.

AN illustrated paper, read at the Ipswich Conference of 1908, on the history of the museum at Ipswich, by the curator of that institution, forms the opening article of the *Museums Journal* for December last. This is one of the few local museums established in the eighteenth century, dating from 1791, when the Rev. William Kirby, the well-known entomologist, was granted the use of a room in the Town Hall as a museum. From this humble beginning the present institution, with its invaluable collection of Crag vertebrates, has been gradually evolved. A great impetus was given in 1846 by a member of the local firm of Ransomes and Sims, when a special building was erected; another advance was made in 1868, when the erection was enlarged, while in 1881 the present handsome building was opened to the public. It is mainly to the energy of the late Prof. Henslow that Ipswich owes its collection of phosphatic nodules containing vertebrate remains from the Crag.

AT the Physiological Laboratory, London University, South Kensington, the opening lecture of the year was delivered by the director, Dr. A. D. Waller, F.R.S., on January 10, the Vice-Chancellor, Sir William J. Collins presiding. Dr. Waller took as his subject the positive and negative phenomena attendant upon the activity of living matter, as illustrated by the electrical phenomena aroused in the retina by light. He showed experiments demonstrating the double effect of light upon the retina, and demonstrated similar currents in response to electrical stimuli. Experiments on nerve were shown in illustration of the same principle, and the effect of anæsthetics at definite percentage was demonstrated with the aid of Dr. Waller's chloroform balance. The effect upon muscle of anæsthetics in solution was demonstrated as a lantern experiment, the physiological equivalence brought out by this method being that one molecule of chloroform is physiologically equivalent to ten molecules of ether and to 100 molecules of alcohol. This method is also convenient for the physiological standardisation of drugs. The Vice-Chancellor, Sir William J. Collins, spoke of the laboratory as fulfilling in one subject, physiology, the general aim of the University, since its re-constitution, to become a seat of learning, to bring to a focus at the headquarters of the University the knowledge and talents of the distinguished men in the many colleges of the metropolis, and congratulated Dr. Waller on the success that had attended his efforts during the last seven years. The Vice-Chancellor referred to the liberal donors who had supported the work financially, Sir Walter Palmer and Mr. George and Mr. Alfred Palmer at the University, South Kensington, and Dr. Ludwig Mond and Dr. Plimmer at the University, University College.

IN connection with the proposed utilisation of the river Tuolumne, flowing through part of the famous Yosemite National Park, California, as the source of a water-supply for San Francisco, Mr. J. Muir contributes a short article to the *Century Magazine* (January) on this valley, the Hetchy-Hetchy. It is not difficult to understand that this is the home of magnificent specimens of California live-oak and white pine, below which the ground is tufted "with ceanothus and manzanita bushes, azalea and brier-rose." Fortunately, the conversion of a valley into a water-reservoir does not necessitate the annihilation of natural scenery, and this article will serve its purpose if such a disaster is averted.

AN investigation of the nuclear changes during the first division in the pollen mother-cell of species of Œnothera, undertaken by Mr. R. R. Gates to look for an explanation of the hybrid and mutant formation in the genus, is described in the *Botanical Gazette* (July, 1908). The early stages of the first heterotypic division appear to favour the end-to-end rather than the lateral union of homologous chromosomes. It was observed that frequently pairing of the chromosomes on the nuclear spindle fails to take place, with the result that two chromosomes of a pair proceed to the same instead of to opposite poles, and so enter the same daughter nucleus. If the chromosomes are transmitters of definite characters, one nucleus would then be lacking in a certain character, and thus a hypothesis may be deduced for explaining the peculiarities noted.

THE recently published number of the Transactions of the Royal Scottish Arboricultural Society (vol. xxii., part i.) contains the report of a lecture by Sir Herbert Maxwell on the need for scientific management and extension of the forests in the United Kingdom. He points out that the proportion of woodland to the total area is about 4 per cent., less than in any other European country, and that the existing woods are a source of great expense instead of producing revenue. It is instructive to contrast with this an article on the Zürich woods by Mr. F. Story. These date back to the fourteenth century, and yield a good annual profit. Beech forms the bulk of the hardwood forest; sycamore and ash come next in importance, while oak is practically disregarded; spruce is the most valued conifer. Within modern times a saw-mill and turnery, also apparatus for drying and impregnating timber, have been introduced.

IN a memorandum on the meteorology of India during October and November, 1908, Dr. G. T. Walker, director-general of observatories, discusses in detail the conditions likely to affect the precipitation of January and February. From present data and from experience gained from the indications of previous years, the inference drawn is that it is "probable that the amount of rainfall in northern India and of snowfall on the neighbouring mountain areas will, at any rate during the earlier part of the season, approximate closely to the average."

IN the *U.S. Monthly Weather Review* for September last Prof. C. F. Marvin describes a new form of compensated siphon barograph, consisting of three separate parts, which he has invented and has found to give very satisfactory results. The long and short branches of the siphon are simple, straight tubes fitted into the upturned branches of the bend, or U. This three-piece construction enables the barometer to be filled very easily, and, when once filled, it can be dismantled and transported without loss of the vacuum. In the barograph illustrated in the paper the changes are magnified five times by means of a large and small wheel operating on the principle of the wheel and axle, with a pen marking upon a drum driven by clockwork in the usual way. The drum revolves once in three days and two hours, moving at the rate of about a quarter of an inch per hour. The instrument is provided with a time-marking device consisting of an electromagnet, which operates once each hour. A small section of an actual record is reproduced in the paper, and shows that the pen responds to minute changes of level of the mercury. Prof. Marvin concludes by giving useful illustrations of the various methods adopted in filling barometer tubes.

THE British Fire Prevention Committee has just published two pamphlets giving particulars of experimental tests which have been carried out by it of the merits of asbestos cloths, sand, steam, hand-pumps, buckets of water, and other appliances in common use for extinguishing fires when they originate. The tests appear to have been thorough, and they were also carried out with impartiality, so that the records furnish valuable data for determining which is the most suitable equipment to adopt in given circumstances.

THE current number of the *Zeitschrift fur physikalische Chemie* (January 5) contains a contribution by E. Cohen and H. R. Kruyt on the E.M.F. of the Weston cell. They are unable to confirm the abnormal results for 10 per cent. and 12·5 per cent. cadmium amalgams described by Janet and Jouaust, but are in agreement with Bijl's views. At 0°, cells made up similarly show variations amounting to 0·2 millivolt, and if an accuracy of this order is required in comparisons at low temperatures the cells must be immersed in a bath. Full details are given of the precautions taken to secure the purity of the materials used, and a diagram is given of a convenient form of cell.

THE notification of the Metropolitan Gas Referees for the year 1909 is practically identical with that for 1908. In addition to a detailed account of the construction of the apparatus used, methods of testing are laid down for the detection of sulphuretted hydrogen, the determination of the amount of sulphur compounds (other than sulphuretted hydrogen), of the illuminating power with the London Argand, No. 2, and with the flat flame, of the gross and net calorific values, and of the pressure. Of these, the only figures now subject to statutory requirements are the sulphuretted hydrogen, pressure, and illuminating power as measured by the No. 2 London Argand.

IN a paper published in No. 4, vol. xxviii., of the *Astrophysical Journal*, Prof. Fowler and Mr. A. Eagle describe a method whereby from any prismatic spectrum a rectified copy, for comparison with a grating spectrum, may be obtained; the importance of such a method will readily appeal to all spectroscopists. Dr. E. S. King has previously obtained such corrected copies, but, apparently, he secured the necessary adjustments of his copying apparatus by trial. In the method now published these adjustments may be calculated so that the apparatus may be set up straightway, and very accurately rectified spectra obtained. The writers state the formulæ they have developed for this purpose, and also give an example to illustrate the accuracy of the results obtained. In a section of the spectrum of the iron arc, extending from λ 4823 to λ 5127, the greatest error in the result amounted to only 0·1 of a tenth-metre; this corresponds to a displacement of about 1/300 of an inch, the range of the whole spectrum being more than 10 inches.

MESSRS. ISENTHAL AND CO.'s new list of rheostats contains illustrations and particulars of many forms and types of resistances for switchboards, bridges, and experimental work. A neat form of potentiometer rheostat is shown, which consists of a cylindrical block of serpentine having a helical groove cut on its outer surface, into which the wire is placed. A central spindle is firmly fixed to the block, and a screw-thread is cut on this spindle having the same pitch as the helical groove on the block. A tube fits over this spindle and carries the sliding spring which makes contact. An ebonite knob fixed at the top of the tube enables the sliding contact to be moved gradually along the whole length of the wire, and its position can be read off on a scale engraved on the spindle of the tube. Coarse adjustments can rapidly be made by pressing a button on the central rod, which releases the contact and enables it to be displaced in a vertical direction. When the button is released the contact always automatically replaces itself on the wire, and cannot fall between the turns. Some good regulating resistances with sliding contacts are also shown. These are made up of slabs of hardened asbestos, which may be mounted up together to form magazines of ten or any number of slabs. The contact levers each work between two slabs, making contact on both simultaneously. The contact fingers are very carefully made, and ensure a more gradual regulation than is usually the case in this type of resistance. The potentiometer rheostat mentioned above is also adapted to a Wheatstone drum bridge, which is made with a fixed drum and an additional direct ohm scale. Plug contacts for the comparison resistances and the terminals are carried on the base, and the resistances of 0·1, 1, 10, 100, 1000 ohms are enclosed in a ventilated box on which the whole is mounted. Several types of electric furnaces are also described.

THE first article in the February number of *Travel and Exploration*, published by Messrs. Witherby and Co., is on Dr. Sven Hedin's explorations, by Sir Thomas Holdich. Among other articles in this attractive magazine is one by Dr. C. G. Seligmann, on the Veddas of Ceylon. The interesting text and brilliant illustrations should make the magazine appeal to a wide circle of readers.

Science Progress for January well maintains its usual high standard of interest. The articles on the destruction of wood by fungi, by Dr. A. H. Reginald Buller; the south-eastern coalfield, its discovery and development, by Mr. Malcolm Burr; and the Palæolithic races and their modern representatives, by Prof. W. J. Sollas, will appeal to a wider circle than the remaining more technical articles. A characteristic paper by Prof. H. E. Armstrong, entitled "A Dream of Fair Hydrone: a Chemical Idyll," will be read with interest by chemists.

WE have received a copy of the thirty-sixth annual issue, that for 1909, of "Willing's Press Guide." It contains a comprehensive index of all newspapers, magazines, reviews, transactions of learned societies, in fact, of every form of periodical literature published in the United Kingdom.

The guide also provides a list of the principal colonial and foreign journals and a variety of general information. This useful work of reference is published at 125 Strand, London, and its price is 1s.

The current number of the *London Quarterly Review*, which is published by Mr. Robert Culley, is rich in thoughtful articles on subjects receiving great attention just now from intellectual readers. We note, in particular, articles by Mr. J. Butler Burke on materialism and life, and by Mr. Henry Gulliford, of South India, on "Todas and Tibetans: a Study in the Evolution of Religion." In addition to articles, the magazine provides notes and discussions on literary and theological topics, and an unusually large number of reviews of recent books.

Two large coloured maps, showing respectively the political boundaries and economic products of Brazil, have been issued by the director of the Mission Brésilienne, 28 Boulevard des Italiens, Paris. Upon the back of each sheet is printed a large amount of useful information relating to the general political and economic geography of the country.

The Carnegie Institution of Washington has published the seventh of a series of volumes which will form eventually a complete index of economic material in documents of the States of the United States. The present volume deals with California from 1849–1904, and has been prepared for the department of economics and sociology of the Carnegie Institution by Adelaide R. Hasse, of the librarian department of public documents, New York Public Library. The scope and character of this exhaustive index have been explained in these columns in referring to previous volumes.

Messrs. Cassell and Co., Ltd., have published a booklet, written by Mr. H. H. Thomas, on "Sweet Peas and how to Grow Them." The text contains just that practical information the amateur gardener requires, and includes numerous illustrations from photographs and sketches.

OUR ASTRONOMICAL COLUMN.

Recent Brilliant Fireballs.—Mr. W. F. Denning writes:—A brilliant Quadrantid passed horizontally, with a slow motion and long course, along the W. heavens on January 6, 8h. 40m. Other fine meteors were noticed on January 7, 9h 27m.; on January 11, 5h. 30m., 7h. 40m., 8h. 11m.; January 13, 9h. 48m.; January 17, 8h. 20m.; January 19, 5h. 50m., 7h. 50m., &c. But the most striking object of all was that of January 11, 8h. 11m., and a large number of descriptions of the appearance and position of this brilliant visitor have come to hand. From these I have worked out the real path as follows:—Height, 58 to 29 miles over Llandovery to Usk, South Wales; length of path, 52 miles; velocity per second, 13 miles; radiant point, $332°+36°$; earth point, Chippenham, Wilts. The meteor was estimated by Mr. H. Chapman, of Newtown, N. Wales, as brighter than the full moon, and it gave two flashes of sufficient intensity to light up the firmament and terrestrial objects for several seconds. The meteor moved slowly from a radiant in the western sky. Several of the observers describe the motion as undulatory, as though the object experienced some difficulty in penetrating our dense atmosphere. The radiant point is not conformable with that of any known meteoric shower, but it falls in the same place as that of an active stream or streams visible in the months of July, August, and September.

Martian Features.—In No. 34 of the Lowell Observatory Bulletins Prof. Lowell describes, and gives the positions of, certain white spots which have been observed in the arctic and subarctic zones of Mars, time after time, by the Flagstaff observers. Eight of these spots have been recorded, and they do not appear to be restricted to any zone, although, individually, they always appear year after year in the same place. The chief of them appears in long. 206°, lat. 83° N., and was first observed by Schiaparelli in 1884; in 1903, at Flagstaff, this spot was kept under observation from June 21 to August 10 (Martian dates), being seen at every one of the six presentations.

To account for the appearance of these white spots a natural supposition would be that they are snow-fields or glaciers on high mountain tops; but observations show that there are no considerable mountains on Mars, therefore the question as to the nature of these phenomena remains to be solved by future discussion.

In a paper communicated to the Royal Astronomical Society (Monthly Notices, vol. lxix., No. 2, December, 1908) M. Antoniadi discusses a composite drawing which he made from a print showing forty images of Mars, taken at the Lowell Observatory. The analysis of the photographs and the comparison of the results with those previously obtained from visual observations lead to some important conclusions respecting the objective existence of certain features about which various visual observers have hitherto disagreed. In general, the photographs confirm the existence of many features reported by Schiaparelli, Lowell, and others, and, what is perhaps more important in the discussion of the results obtained by different observers at different epochs, they afford strong evidence of change in several important features of the planet's disc, *e.g.* the Syrtis Major is shown to be of a slightly different shape on these photographs, taken 1907, July 11, from that observed visually by Schiaparelli between 1877 and 1888.

Atmospheric Polarisation.—In an extract from the *Astronomische Nachrichten* (No. 4283) Herr Chr. Jensen discusses the question of atmospheric polarisation, and shows that there are two neutral points where there is no polarisation. These two points are shown to vary with the solar activity and the amount of volcanic dust and other impurities in the atmosphere, and the author suggests that more observations should be made by meteorologists and astronomers in order to elucidate the question of relationships suggested by the results of his discussion.

Making a Forty-centimetre (15·7 Inches) Cassegrain Reflector.—In a brief note which appears in No. 4295 of the *Astronomische Nachrichten* M. Schaer describes the method of making a 40-cm. Cassegrain reflector, which he has made and has found very efficient at the Geneva Observatory.

The large disc is 7 cm. in thickness, and is pierced by a central hole 8 cm. in diameter; the method of mounting is the older one employed by Herschel, and is found to give sufficient resistance to the flexure of the mirror.

A great disadvantage in a Cassegrain telescope, as compared with a refractor, is the amount of stray light which enters the ocular and reduces the contrast of the image. This may be eliminated by suitable diaphragms, but it is a difficult matter to fix the latter in exactly the correct position. M. Schaer has surmounted this difficulty by mounting a conical tube inside the telescope, so that the stray light is intercepted before it reaches the eye-piece. This conical tube is made of thin sheet iron, and is 150 mm. long; the diameter of the open end is 60 mm., that of the eye end 75 mm., and as the focal plane is limited to 70 mm. diameter, this additional tube in no way interferes with the image.

Tests made with this instrument indicate that in intensity of the focal image it is superior to a crown-flint refractor of equal aperture, whilst its superiority for photography is obvious in many directions.

The Poles of Double-star Orbits.—In No. 4291 of the *Astronomische Nachrichten* Prof. Doberck discusses the relation of the poles of double-star orbits to the ecliptic and to the galaxy. The results show that the poles do not lie along the galaxy nor near the pole of the ecliptic, but it appears to be more probable that they lie along the ecliptic than that they lie near the galactic pole.

Remarkably Dark Penumbral Eclipse of the Moon.—Visual observations and photographs made at the Juvisy Observatory show that the penumbral eclipse of the moon, which took place on December 7, 1908, was an exceptionally dark one. By giving short exposures on slow plates

it was found possible to obtain photographs on which the contrast between the eclipsed and uneclipsed parts of the lunar disc was very striking; on the photograph reproduced the latter is almost entirely obscured.

Several other observations recorded in the January *Bulletin de la Société astronomique de France* confirm those made at Juvisy.

L'Annuaire astronomique et météorologique, 1909.—Amateur astronomers and meteorologists who read French will find M. Flammarion's year-book a valuable acquisition. The volume for 1909 contains the usual data, with the calendar of events so useful to amateur observers and others interested in astronomical phenomena, and some useful instructions to observers; the annual review of the progress of astronomy during the past year should also prove interesting. The "Annuaire" is published at 1.50 francs.

THE BRITISH SCIENCE GUILD.

The third annual general meeting of members of the British Science Guild was held at the Mansion House on Friday last, January 22, under the presidency of the Right Hon. the Lord Mayor. We give this week extracts from the report of the executive committee presented by Sir W. Ramsay, and adopted on the motion of Sir Frederick Pollock, seconded by Sir Oliver Lodge.

The president of the Guild, in his address at the annual meeting last year, remarked:—"It is known now that without skill it is impossible to hold your own in the competition of the day. The change that has come over things in the last fifty or sixty years is immense. Without science no one can organise his business; without science no nation can keep its place in the van. Therefore, one of the great responsibilities of the nation is, not only to keep her knowledge in the minds of a few individuals abreast of the age, not only to produce her Kelvins and her Darwins, but to see that her science is disseminated and that it enters the mind and actuates the endeavours of her Captains of Industry generally. This is the creed of the Guild, and that is the lesson which we ourselves have endeavoured to teach."

During the year the Guild has steadily laboured forward, and, in spite of the vast quantity of inertia against which its missionary efforts have to contend, the nation is gradually commencing to realise the importance of the scientific spirit. Public speakers, particularly those who have to do with educational subjects, are almost unanimous in urging the importance of the inclusion of science in all educational schemes.

Dr. Warren, the Vice-Chancellor of Oxford University, at the last annual meeting made the following striking remarks:—"If there is one thing about which I have been persistently keen all through my academic career, it has been the desire to introduce science into the regular and compulsory curriculum of Oxford, to ensure that everyone who takes the ordinary degree should at least know what science and the scientific attitude of mind are like. I hope I shall see this accomplished before my own active career closes."

Following this, Sir William Anson, the representative in Parliament of the same University, has recently said:—"No boy should leave school without the rudiments of one branch of science and some knowledge of scientific method."

The Chancellor of the Exchequer recently affirmed at Bangor that what is wanted is not only teachers, but also explorers. Science has its dark continents, unlimited oceans, chartless. Germany has said, You must have a university to teach and to educate and to develop the German mind, and now the effect is seen in the German industries.

Visiting recently one of the largest workshops in Germany, he was taken round by a professor. In these workshops the professors are the experts. The Germans get their ideas from their professors. We in this country heave coal and blast rocks, but the great industries that finish these products are elsewhere. The universities are the factories where the future of the country is being forged. *There is no investment that will produce such a return, not to the investor, but to the generations to come, as the endowment of higher education.*

The public Press is also becoming more constant in pointing out the need of scientific education; in urging that with each year it becomes more clear that scientific knowledge is the root of both social prosperity and social progress; that the real function of a university is not to teach men a business, but to cultivate their intellects, to make them the best possible citizens, and, humanly speaking, the most accomplished citizens; that a university ought to be the nursery of our leaders of industry, of our politicians and professional classes; *of all men, in fact, upon whose initiative and by whose counsel the great affairs of the nation are carried on.*

It was mentioned in last year's report that the main educational advance had been in primary education. This has again been the case in the year just passed. Of course it is of the utmost importance that primary education should be efficient, because unless there is a sure foundation the edifice can never be satisfactorily completed; but it must be remembered that secondary education is also of the highest importance. Unfortunately, owing to religious and denominational differences, there is much unrest in the educational world, and this most seriously militates against efficiency. Until some adequate settlement, agreeable to all parties in the controversy, is arrived at, the cause of true education must inevitably suffer.

In Scotland, where sectarian strife is happily non-existent, primary and secondary education reach a much higher level than in the rest of the United Kingdom. It is with the sincerest pleasure that we note the passage into law of the Scottish Education Bill, which deals in particular with compulsory attendance at continuation schools.

In connection with the higher scientific and technical education, the Imperial College of Science is now being organised, and the appointment of Dr. Bovey as its principal is noted with particular pleasure. As a consequence of this reorganisation, the technological education of London is being placed on a much firmer footing.

The Senate of the University of Manchester, having realised the necessity of the times, are fitting out new laboratories, a number of them to be employed entirely for chemical research in connection with commercial problems.

In last year's report attention was directed to the very meagre national endowment of the universities of Great Britain and Ireland. It is much to be regretted that the Government have not seen their way to increase this national endowment, which, compared with what is granted to universities abroad, is infinitesimal. The sight of the ancient universities struggling to obtain an adequate sum from private sources to enable them to carry out needed reforms is one which could not be witnessed on the Continent of Europe.

It is now universally admitted that those countries which most efficiently support their universities and technical schools, and where education of the highest class can be obtained the most readily with the lowest fees, are most in a position to command the markets of the world. Surely it is high time that more attention was paid by the State to the needs of the universities and colleges. It should be realised that there are many steps to be taken beyond primary education if the nation is to be in a position to compete with its rivals. Our national system of education must eventually include the universities.

The neglect of higher education, and the difficulties of finding ways and means which the universities have had to put up with, account for the loss of many specialised trades to the country. Little can be expected from a university or technical institute which is always in the throes of trying to make income balance expenditure. It sometimes happens that a beneficent donor will give a new wing or building to a university or institute, but forgets that such a building will require a staff and an income to keep it up. The consequence of this is that fees are often exorbitant, and students who have the ability to take advantage of the instruction, but not the pecuniary means, are prevented from attending. It also causes the staff to be inadequate, overworked, and underpaid. An overworked staff is unable to spare time for original investigation, and

the natural sequence is that unless they have extraordinary energy they neglect research, lose their originality, and in consequence, become inefficient teachers.

We are glad to acknowledge that in many ways the present Government has made new departures in directions which cannot fail to benefit the nation by bringing science to bear more fully upon various departments and utilising it to greater effect.

We also note an increasing recognition of the national importance of the work done by scientific men, and of the men themselves as nation builders. A remarkable indication of this new spirit was recently afforded by the official dinner, presided over by a Cabinet Minister, given to the members of the International Conference on Electrical Units, and provided for out of a new fund.

The new Irish Universities' Bill, which enacts that universities shall be erected and endowed in Dublin and Belfast, is very welcome, and there is already some evidence that advantage will be taken of the greater educational opportunity thus given to the Irish people.

The Colonial Office, after consultation with the Royal Society, has established a national bureau in London to deal with sleeping sickness, that terrible disease which decimates yearly the population in many of our tropical possessions. The cost of administration is to be defrayed from imperial funds, including a contribution from the Sudan. The bureau was established in June, and one of the rooms of the Royal Society has been placed at its disposal.

After centuries of neglect, the condition of our ancient and historic monuments is now recognised as a matter worthy of the nation's care. Three Royal Commissions have been appointed dealing with them in England, Scotland, and Wales respectively.

The Board of Trade has appointed a committee to deal with international exhibitions, in order to organise and arrange the part to be taken by this country in connection with them. This permanent committee is to take the place of the special commissions which have in the past been appointed by Government to deal with each large international exhibition. In all probability, by having a permanent committee, a more continuous policy will be evolved. The French have had such standing committees for many years, the committees having to deal both with internal exhibitions and with those held outside France. They have also a special organisation to deal with jury awards, and it would be well if some such organisation could be arranged in this country. The value of such an organisation was particularly noticed by those who served on the juries at the Franco-British Exhibition. The French jurors came over here completely organised, but the British jurors had to start their organisation *de novo*. If there had been a British standing committee to arrange beforehand the *modus operandi*, this would not have been the case, and much valuable time would have been saved.

In consequence of the new allocation of the land following the withdrawal of the Board of Education from South Kensington, the Solar Physics Observatory, which was founded by the Government in 1879, and located there as a temporary measure, is to be removed elsewhere. It has been decided to locate it near Caterham, to occupy a position 900 feet high, previously a mobilisation centre, which has been placed at the disposal of the observatory by Mr. Haldane. In the near future, therefore, it will be possible to carry on the important investigations under much more satisfactory conditions.

The President of the Local Government Board has authorised for the current year a large number of researches in connection with the annual grant voted by Parliament in aid of scientific investigation connected with the causes and progresses of disease; also chemical and bacteriological investigation, as to the influence of softening and other chemical processes on the purity of water supplies from chalky sources.

The Board of Agriculture has shown increased activity, and although little is so far done for research, pamphlets of great use to farmers have been widely distributed.

The appointment of these committees and the increased means of research are steps in the right direction, but they are purely departmental.

It is interesting in this connection to direct attention to the speech made by our president at the anniversary dinner of the Chemical Society nearly four years ago (*Daily Telegraph*, March 30, 1905):—"Mr. Haldane expressed his conviction that the problem that lay in front of the British nation was how to develop the grey matter of the executive brain. All the controversies that agitated the minds of politicians were of less importance than the big question of how to make the permanent element in politics more powerful and better. There was too little science in it at the present time. There was hardly a department which did not require the aid of science if it was to be effective, but there were not attractions like those held out by private firms and foreign Governments to lead men of the highest attainments to put themselves at the disposal of the State. Was it impossible to hope for the birth of an era when the head of the Government should have at his disposal a corps of the finest brains which the nation could produce? If great Britain was to hold her own, she must not be behind Germany, the United States, or France in this matter."

The importance to the nation of such a council as that referred to by Mr. Haldane was first pointed out by the Duke of Devonshire's Commission in 1874.

As mentioned in last year's report, a deputation of the Guild on the pollution of rivers and water supplies was received by the Right Hon. John Burns (President of the Local Government Board) on October 31, 1907. Mr. Burns expressed his intention of bringing in a Bill to deal with the subject in the spring of 1908. No legislation upon this subject was, however, brought forward. It is hoped that this does not mean that nothing is to be done next session, as the matter is one of the utmost urgency.

Conveyance of Scientific Literature at Reduced Rates.

The question of a reduction in postal rates on scientific literature was brought before the Postmaster-General by a deputation organised by the Guild, and received by him on March 12, 1908.

The following memorandum was submitted to the Postmaster-General by the deputation:—

This deputation has been organised by a committee of the British Science Guild, and represents seventy-five societies which have asked to have this matter favourably considered. The names of these societies are given as an appendix.

This list of societies is very far from exhaustive, and, as a matter of fact, only 100 societies were consulted in the first instance, a good many of which by their position could not take action in this matter. It will be understood, therefore, that there is an almost unanimous desire on the part of the scientific and learned societies in Great Britain and Ireland that the Government will see its way to help them in the matter which is now put forward.

These societies fully acknowledge the sympathetic treatment which a few of their number have received from the Government in such matters as the provision of rent-free quarters, monetary help in the prosecution of original research, in exemption from income tax, and in other ways, but they wish to point out that only a few societies really benefit by the first two of these concessions, and that even then this help is small.

The societies wish, however, that these may be taken as precedents for conferring upon them the further small benefits which they now ask for.

This deputation would claim that the scientific and learned societies in this country are thoroughly deserving of sympathetic and generous aid from the Government, for the advancement of science and of original investigation in Great Britain is to a large extent due to their fostering care and to the fact that they afford facilities for the publication of original work and for its free discussion, and by circulating large numbers of their proceedings and transactions describing such original work, they disseminate widely the most recent scientific and other discoveries.

The societies in question are thus practically the custodians of the national advance in science, and it is almost a truism to say that the material progress of the country is strictly dependent on the applications of science, and hence that such societies help largely in keeping our country in a position to compete with other countries in commerce and industry, and that without this continuous

advance in scientific work Great Britain must gradually recede from its premier position among nations.

The work of these societies not only fosters the advance of science, but it is largely educational, and this educational work is of the highest type, as it follows on after the ordinary general education is finished. The present Government, it is known, is keenly anxious to foster education in every possible way, and it is suggested that this is a legitimate direction in which aid is at once possible without any reference to politics and without undue expense.

The deputation wishes to urge very strongly that these societies are in no way working with the view of ulterior profit, but that they work solely for the advancement of knowledge and the well-being of our country. The deputation would invite reference in this connection to the balance sheets of various societies, and from these it will be seen that their expenditure is solely with the view of fostering science, and that in no way does any profit accrue to their members.

The cost of the publication of the journals of the various societies is a very large item in their expenditure, and the cost of the postage of their journals to the members is in many instances a very heavy tax on their resources. This item of cost handicaps such societies in many ways. A reduction in the rate of postage would give great relief to such societies, while the cost to the Post Office, and finally to the public, would be almost nominal.

So heavily do some of the societies feel this rate of postage on their publications that they now actually employ their own servants or special messengers to deliver their publications in London with considerable saving in expense to themselves. Cases may be mentioned showing this.

The deputation does not ask for any precise amount of reduction, but would plead for some consideration and help in the matter, and in passing would mention that the newspaper rates in this country are much lower than the rates at which scientific publications can be sent. The deputation also does not suggest any very hard and fast definition as to the line to be drawn between the publications of learned and scientific societies and other serial publications, but it is suggested that the case of each society, applying for any favourable rate which might be granted, should be considered by the Postmaster-General himself, and if he is satisfied that such society is working wholly (*a*) for the public benefit; (*b*) for the advancement of knowledge or learning; (*c*) without any view to profit to its members, and fulfils any other conditions the Postmaster-General may think fit to add, then such benefit could be granted to each individual society which may be approved.

With this end in view, the following is a suggested regulation for any concession which the Postmaster-General and the Government might be pleased to make:—

"Any publication coming within the following description can, on the application of the society, and upon payment of an annual fee of 5*s*., be registered at the General Post Office for transmission by inland post as a publication of a society as hereinafter defined."

DEFINITION OF A PUBLICATION.

(*Under this Section.*)

"All such scientific, learned and technical publications as may be issued periodically not for profit, but for the advancement of knowledge by societies and institutions in the United Kingdom."

The deputation would urge that such a regulation (which may, of course, be amplified if necessary) would at once differentiate the publications for which relief is sought from all magazines and other similar periodical matter which are published as commercial speculations, whereas, on the other hand, if the rates of postage to be given to the periodicals by scientific societies are reduced, the definition above given could equally be used to assimilate their treatment with that already given to the newspapers in this country.

The executive committee of the Guild subsequently decided that it is undesirable to proceed at present any further in this question, but it is hoped that circumstances may prove to be more favourable later, when perhaps a further move may be made.

Reports of Committees.

During the year meetings of a number of committees have been held. In some cases the results obtained have been incorporated in the form of reports, from some of which extracts are given below. Two reports upon educational subjects appear elsewhere in the present issue.

Coordination of Charitable Effort.

At the last annual meeting of the Guild Sir William Bousfield directed attention to the want of coordination in charitable effort, and suggested that this would be a very fitting matter for the Guild to inquire into. As a consequence, a subcommittee was appointed to deal with the subject. In a memorandum drawn up for the committee Sir William Bousfield says:—

"There would appear to be few subjects on which scientific thought and deductions from practical experience in the past would be more valuable to the community than those relating to expenditure on relief of the poor and provision for sickness and incapacity for work. The amount spent at present out of the national income on these objects and the waste is extremely great. The funds are provided by the State, including central and local authorities, by subscriptions made by the classes who receive the benefit, and by voluntary contributions given in the form of charity by the wealthier sections of the public.

"The time seems to have come when the relation of these various efforts towards the same objects should be examined from a general and national point of view. At present there is no common aim realised by those who improve the lot of the needy or of persons depending on weekly wages and their families. There is a great overlapping in administration, owing to the absolute ignorance of charitable people as to what the working classes are themselves doing, or what provision is being made by the State, and *vice versâ*. New charitable organisations are constantly springing up on a large scale, which merely duplicate the work of others and add greatly to the cost without necessity.

"The general effect of this want of system has been very unfair to the poor themselves, and has promoted a pauperised spirit.

"The want of recognised principle to guide the community in its aim of improving social conditions leads to all kinds of contradictory proposals, and Parliament and the nation alike are at sea and in a state of bewilderment when wide and far-reaching schemes for that end are set on foot."

Agricultural Committee.

A committee has been formed to inquire into the present condition of agricultural research. Mr. A. D. Hall has drawn up a report dealing with agricultural research in the United Kingdom. Mr. John Percival has drawn up a report dealing with the state of agricultural research in the Netherlands, Sweden, Denmark, and Germany, and the amount of State aid which is extended to the different experimental farms and institutions. The subject, however, being very broad, there still remains a large amount of work for the committee to undertake.

Franco-British Exhibition.

Owing to the action of the executive committee of the Guild in 1907, a special science committee, consisting of members of the British Science Guild and representatives of the Royal and other societies, with Sir Norman Lockyer as chairman, organised a separate Science Section of the Franco-British Exhibition. The executive of the exhibition most generously granted to the committee the use of the large building, which was specially erected for the purpose, having a floor space of 14,000 square feet. Not only did they build and grant this hall free of cost, but they also contributed a sum of 1000*l*. to defray the cost of the glass exhibition cases, with installation and other expenses. The total contribution of the executive to the cause of British science exceeded 7000*l*. The Guild feel that this public-spirited action on the part of the exhibition authorities calls for the highest praise. In no other international exhibition has a special portion been entirely devoted to science.

The Synchronisation of Clocks.

Attention was directed in the public Press by Sir John Cockburn to the divergence in time shown by the publicly exposed clocks in London and other large centres, also the inconvenience thus caused to the public. A suggestion was received by the executive committee that a subcommittee should be appointed to deal with the subject.

After careful consideration of evidence brought before it, the committee drew up the report printed in NATURE of August 13, 1908. This report was sent to the Lord Mayor, the London County Council, the General Post Office, His Majesty's Office of Works, the Local Government Board, the British Horological Institute, and the various railway companies. Most of the bodies referred to merely acknowledged receipt of the communication, or else expressed disinclination to act owing to administrative difficulties or to the expense of synchronisation. The reply received from the Public Health Department, Guildhall, City of London, is of special interest, as it states "that the Corporation on March 26, 1903, made it a condition of future consent to the erection of clocks over public ways in the City that they should be synchronised with Greenwich time."

Naming of Streets.

The executive council has considered the matter of naming new streets, and the re-naming of streets, the names of which it is intended to alter, after distinguished men of science, now deceased. The members of the executive committee were requested to send in names which they considered it would be desirable to employ in this way. A list containing a large number of names was thus drawn up, and was presented to the executive committee, who, after careful consideration, reduced it to the following thirty-one names:—Newton, Darwin, Harvey, Jenner, Huxley, James Watt, Gilbert, Kelvin, Faraday, Joule, Clerk Maxwell, Stokes, Tyndall, Captain Cook, Livingstone, Franklin, Ross, Bruce, Mungo Park, Cavendish, Dalton, Priestley, Boyle, Andrews, Halley, Herschel, Horrocks, Adams, Bradley, Howard, Piddington. This list was then sent to the County Council with the following letter:—

"I am directed by the president, Mr. Haldane, to ask you to be so good as to bring before the L.C.C. the striking difference which exists between the street nomenclature in London and Paris. In the latter City there is no illustrious French man of science whose name is not connected with some street or square. It is hardly too much to say that in London there is no case of which the same can be said."

"This matter has been inquired into by the executive committee of the British Science Guild, and I am directed to forward to you the accompanying list of thirty-one names, which they have carefully considered, and think could be properly used in this connection should the opportunity arise in the naming of new thoroughfares or the change of name of old ones."

"They are well aware that the present condition of things has arisen in the past because there has been no such body as the London County Council interested in the nation's history and intellectual development; in its absence, the builder and the owner of the land during the last 300 years have been the chief people interested."

New Patents and Designs Bill.

Two years ago the Guild appointed a committee to consider the question of the amendment of Patent Laws. Sir John Cockburn was also appointed to confer with the authorities of the Associated Chambers of Commerce, and to take part in a deputation to the President of the Board of Trade. It is with pleasure that the Guild is able to direct attention to the beneficial effect of the new Patent Act of 1907, the results of which are now beginning to be apparent.

So far back as 1884, in his presidential address to the Society of Chemical Industry, the late Sir William Perkin said that one of the causes of the loss of the coal-tar colour industry to this country was the condition of our patent laws. For more than twenty years Mr. Levinstein and others have been working to convince the Governments of the need of reform in this direction.

The consequences of the Act now in force are that, not only are many wealthy foreign firms building new factories in this country, but that licences to work foreign patents are being obtained by many purely British firms which, before the passing of this Act, they were unable to secure. Messrs. Meister Lucius and Brunning, of Höchstam Main, in Germany, have erected a factory at Port Ellesmere, on the Mersey, and are now employing a large staff of workmen in the preparation of anilin dyes, synthetic indigo, and fine chemicals. The Badische Anilin- und Soda-Fabrik are also erecting large works on the Manchester Ship Canal. The Gillette Razor Company, of America, have works at Leicester. The German Pottery Co., of Alfred Johnson and Co., are starting works in Kent, and many other firms from abroad are setting up works at Liverpool, Manchester, Warrington, Enfield, Tottenham, and other localities. Altogether about twenty new works have been erected by foreign patentees owing to the passing of this new Act, and independent of these a large number of licences have been granted to British firms.

Formation of Sections in Australia and Canada.

A committee has been formed in Sydney, New South Wales, with the Hon. Sir H. Normand MacLaurin, Chancellor of Sydney University, as chairman, and Dr. Walter Spencer as secretary. A number of members have joined the New South Wales branch of the British Science Guild. In Montreal a strong committee has been brought together, with Mr. George E. Drummond as president and Prof. H. T. Barnes as secretary. It is intended to hold a meeting at the end of the winter, either in Montreal or Toronto, to inaugurate the Canadian branch of the Guild. The formation of branches of the Guild in the colonies will add strength to the parent society, and cannot fail to foster goodwill between the colonies and the Mother Country, thus helping to strengthen the fabric of the Empire.

Presentation of Illuminated Address to President Fallières.

The opportunity of the visit of the President of the French Republic to England to inspect the Franco-British Exhibition was taken advantage of to present him with an illuminated address. The movement was originated by Sir Norman Lockyer, and after consultation with the Royal Society and the Royal Academy, the Guild was asked to undertake the work. The address was presented on May 27, 1908, at St. James's Palace, and was received by M. Fallières in a most cordial manner.

SYSTEM AND SCIENCE IN EDUCATION.[1]

Primary and Secondary Education.

AFTER taking into consideration the memorandum prepared by the chairman of the executive committee, the education committee has adopted the following resolutions which embody and extend those already submitted to the executive committee:—

(1) No local authority or other body should be empowered to grant total exemption from attendance at school to children under fourteen years of age.

(2) Provision should be made for compulsory attendance at day or evening (preferably day) continuation schools for young persons above the age of fourteen years, who are not attending craft or secondary schools, for two to four hours a week during two years of forty weeks in each year. Pupils attending evening continuation schools between these ages should not be permitted to commence work before 8 a.m. on those days on which they attend the schools. The number of hours during which pupils attend part-time day or evening continuation schools should be counted as "hours of employment" for the purpose of the Acts dealing with the employment of young persons.

(3) There should be established in all educational areas a sufficient number of craft schools with a two-years' course for boys and girls between the ages of about fourteen and sixteen years. Due regard should be paid in these schools to the continuance of the general education of the pupils, but special provision should be made for sound scientific and technical training in relation to the industries or requirements of the district. The aim of these schools should be to provide preparatory training in

[1] Reports of two committees of the British Science Guild presented at t annual general meeting on January 22.

handicraft for pupils who propose afterwards to follow industrial or commercial careers or to manage households intelligently. The fees should be low, and there should be scholarships giving free tuition, travelling, and maintenance allowances, graduated according to the ages of the scholars. These schools might also provide for the continuation classes referred to in clause 2.

(4) Local education authorities should be urged to establish or aid in establishing an adequate supply of secondary schools of a high educational type. These schools should have highly qualified staffs adequately paid, and should be administered by a board of governors or managers. No effort should be spared to make these schools thoroughly efficient, and to this end the curriculum followed should admit of some amount of variation. Where the majority of pupils remain to eighteen years of age a higher standard on the purely academic side could be aimed at than in the case of schools where the bulk of the pupils leave at sixteen years of age or thereabouts. To secure that the best minds in the primary school shall pass into the secondary school, there should be a sufficient number of free places and maintenance scholarships to render secondary education accessible to boys and girls capable of benefiting by it who propose to remain at school until the completion of at least a four-years' course from the date of entry.

(5) A primary school certificate should be introduced which would serve as a passport to the craft school and the secondary school. School certificates should also be granted to pupils who work satisfactorily through the courses at the craft school or at the secondary school. The certificates should be based not upon examinations, but chiefly upon reports by the teachers as to the ability of the pupils to profit by higher courses of instruction.

(6) The matriculation examination of any British university, and the secondary school leaving certificate, certain requirements being satisfied, should qualify for entrance to any British university or technical college, and to the various professional courses, without further examination and in lieu of the present preliminary examinations.

(7) School records and the reports of teachers should at every stage supersede largely the present system of estimating ability by examinations. The award of scholarships should be based largely upon the reports of the teachers of the schools which the pupils are attending at the time of their promotion. School-leaving certificates should be awarded only to pupils in schools certified as efficient for that purpose by a responsible inspecting authority, and a list of these schools should be published. Schools in which this privilege was abused should be removed from the list. By placing upon the teachers the responsibility for nominating pupils for certificates or scholarships, the credit of the school would soon secure that only the most capable or promising pupils would have their passage facilitated to places of higher learning. In all examinations the teacher should be associated with the external examiner.

(8) In every public or private primary or secondary school, the instruction in all branches of the curriculum should be so given as to accustom the pupil to careful observation and experiment, whatever may be the specific nature of the subject that is being studied; and to this end not only should there be a proper amount of labortory and workshop practice, but the scientific spirit of the laboratory and workshop should so far as possible be employed in the ordinary class-room. In this way the school would provide the best kind of preliminary training for industrial life, and would also ensure that those who subsequently receive a university education shall bring to the work which will devolve upon them in various fields of activity, including the administration of public departments, an adequate training in scientific method.

(9) An arrangement should be arrived at whereby a satisfactory report as to educational efficiency, made by a responsible inspecting authority would in ordinary cases render similar inspection during the same school year unnecessary.

(10) Local authorities, governing bodies, and parents should realise that the salaries at present paid are in most cases quite inadequate to secure a supply of highly-qualified and capable teachers. The opportunities for advancement offered by other careers attract from the teaching profession many men, who by attainment and aptitude would promote the educational welfare of the nation. The conditions of service, salaries, and outlook of assistant teachers, whether engaged in the work of primary, secondary, or technical education, are in general most unsatisfactory, and unless they are improved they must fail to attract or retain the services of many men and women best qualified for the profession of teaching. A high standard in education can only be attained by generous provision for those who do the work, both in their active and declining years. Until this is recognised, it is futile to anticipate progress in procedure or success in any organic educational system, or to obtain from the present efforts and expenditure on education a sufficient return.

The Cost of teaching Practical Science in Schools.

An opinion expressed by the headmaster of Eton at a general meeting of the British Science Guild in 1907, to the effect that an extension of the teaching of science in public schools is checked by the heavy expenses attaching to practical work, has been under the consideration of a subcommittee of the Guild, and its members beg to make a brief statement of their convictions with regard to such practical teaching of science and the question of its extension.

The procedure adopted in teaching science should always differ considerably from that employed in teaching literary and linguistic subjects, and ordinarily does so differ. The main reason for this distinction lies in the fact that all exact physical knowledge must admit of objective realisation, that is, its demonstration in material objects under natural conditions must be possible; while the acquisition of any part of this knowledge already recorded, not to mention possible additions to the stock, necessarily involves extensive experience of a concrete character. The equipment for this purpose, still considered in some quarters as more or less separable from the course of instruction, involves expense, but that expense may be regarded, not so much as a defect at once tangible and flagrant in a branch of education still under suspicion, but rather as the life-blood of an activity inherent in modern civilisation. Whether a given society ignores it or turns it to its own use, the movement continues—in Lebensfluthen, in Thatensturm.

Expense is a relative term. All those who have been engaged in teaching science for the last twenty years are aware of a revolution during that period in the character of the apparatus employed for instruction in schools. A remarkable change has taken place in the direction both of cheapness and of simplicity. These results have been gained by organised efforts on the part of science masters by meeting in conference or by publication. It is widely recognised among these masters that simplicity and plainness in apparatus is a positive gain, and that the educational value of the instruction even increases with the bareness of the material by which it is supplied. As experience in this work has widened, it has become more and more apparent that scientific method rather than technical knowledge should be the aim of school teaching, and that in the earlier stages at all events preference should always be given to the study of the course of events which are normal and familiar rather than of such as are exceptional or specialised. There has been, in other words, an increasing tendency to assimilate the scope of elementary scientific study to the ordinary experience of civil and industrial life and the material of experiment to the range of every-day requirements. It is now generally admitted that the over-elaboration of apparatus inhibits enterprise and invention in the young pupil just as a costly mechanical toy stunts the imagination of the child, while it tends also to separate the exercises of the laboratory too abruptly from the events of the daily round. It is maintained that workshop practice may with advantage supplement the work of the laboratory and give it a broader practical basis: that the surviving though weakened boundary-wall between them might be broken down, with gain to both in the matter of increased economy as well as of added wealth of interest.

Such an outlet for the practical exercise of inductive reasoning is an urgent need in a scheme of education which is still very largely a matter of deductive exposition. A large stock of the experience only to be gained from an intimate acquaintance with the qualities and limitations

of matter is a necessary disciplinary corrective of all abstract thinking, whether scientific or not, and we should beware how we repress it lest we destroy that practical-mindedness which we treasure as one of the most valuable of our national assets. Imbued as we are with these convictions, it is discouraging to meet with opinions which appear to have been formed at a period when they were in some measure justified by the direct transference to the school of the practice of the university without the necessary adaptation to a lower intellectual plane, and by other inevitable errors of the early and empirical stage of science teaching. It is some relief, however, that the charge which has to be met is a matter of pounds, shillings and pence, and not one of squandering educational opportunity or of wasting human effort.

Economy bears upon science teaching precisely at it bears upon every branch of education and every department of social administration, nor do its principles perforce wither away in the atmosphere of science. As practical experience extends, as the supply of trained teachers improves, as examinations become more scientific and less restricted in style, so will the spirit of investigation and research be stimulated, and sound standards of thought be established. Indeed, the question of outlay will almost cease to be relevant as the relation of output to expenditure improves, but if definite statements be called for, a wide range of inquiry has furnished them. From the information thus gained, it appears that the present average expenditure on apparatus and material is about 1*l.* per annum for each pupil receiving practical instruction in science in the public schools, and about 10*s.* per annum for each pupil in other secondary schools. It may be safely accepted as a maximum estimate—a fairly generous one—that physical and chemical laboratories can be equipped, maintained in apparatus, and supplied with consumable material, and provision also be made for the practical study of animate nature, on a basis of 100 boys working for 10 hours a week (or 40,000 boy-hours per annum), by an average annual expenditure of 150*l.* for a period of ten years. After this period of installation and accumulation of plant, the annual cost of maintenance and renewal need not exceed 100*l.* In other words, the cost per head should never exceed 30*s.* a year during the early constructive stage, and may be expected to fall much below that value after a period varying with the scope of the work, the degree of specialisation, and the number of students. But it is imperative that expenditure should be guided by experience, for a wrong start by a tyro may hamper himself or his successor for years. For this reason there is much valuable work to be done by any independent body which would undertake to serve as a standing committee for the sifting and coordination of results in these matters, and for advising and guiding those in need.

Save for a few of the chief public schools, the statements here made in connection with secondary education are fortunately to a great extent unnecessary. There are now about 750 secondary schools in England and Wales inspected by the Board of Education and receiving grants for efficient teaching. In these schools there are about 100,000 pupils taking a course which has been approved by the Board, and this course must provide instruction in science. The Board insists that "the instruction in science must include practical work by the pupils." In each of these secondary schools, and they include most of the grammar schools and endowed schools of the country, one or more laboratories must be provided. They are to be fitted with benches for their special purpose, and supplied with water, gas, and, when possible, electric current. Sufficient apparatus must also be provided for a reasonable course of work.

The governing bodies of all these schools must provide laboratories and apparatus for individual practical work whether they like it or no. The schools are not regarded as efficient or entitled to receive grants in aid of education, unless they comply with the regulations laid down by the Board for individual practical work in science. Provision for this purpose cannot be evaded by any secondary school which receives grants in aid, nor, on the other hand, would any reduction in its cost permit the teaching to be extended beyond the limits already imposed by the rightful claims of other subjects. Secondary schools which are less local in character and not qualified to receive grants, but are subject to considerable competition among themselves, are prompted by motives of self-preservation to give a prominent position in their curricula to scientific training. It is now only a few public schools which remain in an exceptional position and offer but limited opportunities of learning science to a portion of their pupils. If an extension of science teaching in such schools be desired, the cost of its provision does not appear to be the real obstacle.

THE WORLD OF LIFE: AS VISUALISED AND INTERPRETED BY DARWINISM.[1]

THE lecturer began by stating that, although the theory of Darwinism is one of the most simple of comprehension in the whole range of science, there is none that is so widely and persistently misunderstood. This is the more remarkable, on account of its being founded upon common and universally admitted facts of nature, more or less familiar to all who take any interest in living things; and this misunderstanding is not confined to the ignorant or unscientific, but prevails among the educated classes, and is even found among eminent students and professors of various departments of biology.

Darwinism is almost entirely based upon those external facts of nature, the close observation and description of which constituted the old-fashioned "naturalists," and it is the specialisation in modern science that has led to the misunderstanding referred to. Those who have devoted years to the almost exclusive study of anatomy, physiology, or embryology, and that equally large class who make the lower forms of life (mostly aquatic) the subject of microscopical investigation, are naturally disposed to think that a theory which can dispense with all their work (though often strikingly supported by it) cannot be so important and far-reaching as it is found to be.

Numbers, Variety, and Intermingling of Life-forms.

Coming to the first great group of facts upon which Darwinism rests, the lecturer directed attention to the great number of distinct species, both of vegetable and animal life, found even in our own very limited and rather impoverished islands, as compared with more extensive areas. Great Britain possessed somewhat less than 2000 species of flowering plants, while many equal areas on the Continent of Europe have twice the number. The whole of Europe contains 9000 species, and the world 136,000 species already described; but the total number, if the whole earth were so well known as Europe, would be almost certainly more than double that number, or about a quarter of a million species. The following table, showing how much more crowded are the species in small than in large areas, was exhibited on the wall. It affords an excellent illustration of the fact of the great intermingling of species, so that large numbers are able to live in close contact with other, usually very distinct, species.

Numbers of Flowering Plants.[2]

	Square miles	Species
The County of Surrey	760 ...	840
A portion containing	60 ...	660
,, ,, ...	10 ...	600
,, ,, ...	1 ...	400

The above figures were given by the late Mr. H. C. Watson, one of our most eminent British botanists, and as he lived most of his life in the county, they are probably the results of his personal observation, and are therefore quite trustworthy.

Continuing the above inquiry to still smaller areas, one perch, equalling 1/160 acre, or less than the 1/100,000 of a square mile, has been found to have about forty distinct species, while on a patch 4 feet by 3 feet in Kent (or about 1/25,000,000 of a square mile) Mr. Darwin found twenty species.

[1] Abstract of discourse delivered at the Royal Institution on Friday January 22, by Dr. Alfred Russel Wallace, O.M., F.R.S.

[2] Other tables illustrating similar facts in other parts of the world were prepared, but not exhibited, as being likely to distract attention from the lecture itself.

The same law of increase of numbers in proportion to areas applies to the animal world, if we count all the species that visit a garden or field during the year, though those that can continuously live there are not perhaps so numerous in very small areas.

The Increase of Plants and Animals.

The powers of increase of plants and animals were next discussed, and were shown to be enormously great. An oak tree may produce some millions of acorns in a good year, but only one of these becomes a tree in several hundred years to replace the parent. Kerner states that a common weed, *Sisymbrium Sophia*, produces about three-quarters of a million of seeds; and if all these grew and multiplied for three years, the plants produced would cover the whole land surface of the globe.

Equally striking is the possible increase in the animal world. Darwin calculated that the slowest breeding of all animals, the elephant, would in 750 years, from a single pair, produce nineteen millions. Rabbits, which have several litters a year, would produce a million from a single pair in four or five years, as they have probably done in Australia, where they have become a national calamity. As illustrative of this part of the subject, the lecturer referred at some length to the cases of the bison and the passenger pigeon in North America, and the lemmings of Scandinavia. In the insect tribes still more rapid powers of increase exist. The common flesh-fly goes through its complete transformations from egg to perfect insect in two weeks, and Linnæus estimated that three of these flies could eat up a dead horse as quickly as a lion.

It is these enormous powers of rapid increase that have ensured the continuance of the various types of existing life from the earliest geological ages in unbroken succession, while it has also been an important factor in the production of new forms which have successively occupied every vacant station with specially adapted species.

Inheritance and Variation.

The vitally important facts of inheritance with variation were next discussed, and their exact nature and universal application pointed out. The laws of the *frequency* and the *amount* of variations, and their occurrence in all the various parts and external organs of the higher animals, were illustrated by a series of diagrams. These showed the actual facts of variation in adult animals of the same sex obtained at the same time and place, which had been carefully measured in numbers varying from twenty to several thousand individuals.

The general result deduced from hundreds of such measurements and comparisons was that the individuals of all species varied around a mean value, that the numbers became less and less as we receded from that mean, and that the limit of variation in each direction was soon reached. Thus, when the heights of 2600 men, taken at random, were measured, those about 5 feet 8 inches in height were found to be far the most numerous. About half the total number had heights between 5 feet 6 inches and 5 feet 10 inches, while only ten reached 6 feet 6 inches, or were so little as 4 feet 10 inches, and at 6 feet 8 inches and 4 feet 8 inches there were only one of each.

The diagrams from the measurements of various species of birds and mammals were shown to agree exactly in general character, and the further fact was exhibited by all of them that the parts and organs varied more or less independently, so that the wings, tails, toes, or bills of birds were often very long, while the body or some other part was very short, a point of extreme importance, as supplying ample materials for adaptation through natural selection.

The Law of Natural Selection.

The next subject discussed was the nature and mode of action of natural selection. It was pointed out that since the Glacial epoch no decided change of species had occurred. This showed us that the adaptation of every existing species to its environment was not only special, but general. The seasons changed from year to year, but the extremes of change only occurred at long intervals, perhaps of many centuries, with lesser, but still very considerable, variations twice or thrice in a century. It was by the action of these seasons of extreme severity at long intervals, whether of arctic winters or summer droughts, that the very existence of species was endangered; and it was at such times that the enormous population of most species and their wide range over whole continents always secured the preservation of considerable numbers of the best adapted in the most favoured localities. Then the rapidity of multiplication came into play, so that in two or three years the population of each species became as great as ever, while, as all the least favourable variations had been destroyed, the species as a whole had become better adapted to its environment than before the almost catastrophic destruction of such a large proportion of them.

It is the fact of the adaptation of almost all existing species to a continually fluctuating environment—fluctuating between periodical extremes of great severity—that has produced an amount of adaptation that in ordinary seasons is superfluously complete. This is shown by the well-known fact that large numbers of adult animals that have not only reached maturity, but have also produced offspring and successfully reared them, continue to live and breed for many years in succession, although varying considerably from the mean, while almost the whole of the inexperienced young fall victims to the various causes of destruction that surround them.

The Nature of Adaptation.

The next subject discussed was the complex nature of adaptations in many cases, and probably in all, a subject of great extent and difficulty. The lecturer directed special attention to the relations between the superabundance of vegetation in spring and summer, the enormous, but to us mostly invisible, hosts of the insect tribes which devour this vegetation, and the great multitudes of our smaller birds the young of which are fed almost exclusively on these insects. Without these hosts of insects the birds would soon become extinct, while without the birds the insects would increase so enormously as to destroy a considerable amount of vegetable life, which would, in its turn, lead to the destruction of much of the insect, and even of the highest animal groups, leaving the world greatly impoverished in its forms of life.

The vast numbers of insects required daily and hourly to feed each brood of young birds was next referred to, and the wonderful adaptation of each kind of parent bird which enables it to discover and to capture a sufficient quantity immediately around its nest, in competition with many others engaged in the same task in every copse and garden, was next pointed out. The facts were shown to involve specialities of structure, agility of motions, and acuteness of the senses, which could only have been attained by the preservation of each successive slight variation of a beneficial character throughout geological time; while the emotions of parental love must also have been continuously increased, this being the great motive power of the strenuous activity exhibited by these charming little creatures.

Lord Salisbury on Natural Selection.

As illustrating the strange and almost incredible misconceptions prevailing as to the mode of action of natural selection, the lecturer quoted the following passage from the late Lord Salisbury's presidential address to the British Association at Oxford in 1894. After describing how the diverse races of domestic animals have been produced by artificial selection, Lord Salisbury continued thus:—

"But in natural selection, who is to supply the breeder's place? Unless the crossing is properly arranged the new breed will never come into being. What is to secure that the two individuals of opposite sexes in the primæval forest, who have been both accidentally blessed with the same advantageous variation, shall meet, and transmit by inheritance that variation to their successors? Unless this step is made good the modification will never get a start: and yet there is nothing to ensure that step but pure chance. The law of chance takes the place of the cattle-breeder or the pigeon-fancier. The biologists do well to ask for an immeasurable expanse of time, if the occasional

meetings of advantageously varied couples, from age to age, are to provide the pedigree of modifications which unite us to our ancestors, the jelly-fish."

Here we have the extraordinary misconception presented to a scientific audience as actual fact, that advantageous variations occur singly, at long intervals, and remote from each other, each statement being, as is well known, the absolute reverse of what is really the case. It totally ignores the fact that every abundant species consists of tens or hundreds of millions of individuals, and that as regards any faculty or quality whatever, this vast host may be divided into two portions—the *less* and the *more* adapted —not very unequal in amount. It follows that at any given time, in any given country, the advantageous variations always present are not to be counted by ones and twos, as stated by Lord Salisbury, but by scores of millions; and not in individuals widely apart from each other, but constituting in every locality or country somewhere about one-half of the whole population of the species.

The facts of nature being what they are, it is impossible to imagine any slow change of environment to which the more populous species would not become automatically adjusted under the laws of multiplication, variation, and survival of the fittest. Almost every objection that has been made to Darwinism assumes conditions of nature very unlike those which actually exist, and which must, under the same general laws of life, always have existed.

Protective Colour and Mimicry.

The phenomena of protective coloration and mimicry were very briefly alluded to, both because they are comparatively well known and had formed the subject of previous lectures, while they are very easily explained on the general principles now set forth. The explanation is the more easy and complete, because of all the characters of living organisms, colour is that which varies most, is most distinctive of the different species, and is almost universally utilised for concealment, for warning, or for recognition; and, further, its useful results are clear and unmistakable, and have never been attempted to be accounted for in detail by any other theory than that of the continuous selection of beneficial variations.

The Dispersal of Seeds.

The subject of the dispersal of seeds through the agency of the wind, or of carriage by birds or mammals in a variety of ways, and often by most curious and varied arrangements of hooks, spines, or sticky exudations almost infinitely varied in the different species, was also briefly treated, since they are all readily explicable by the laws of variation and selection, while no other rational explanation of their formation has ever been given.

Conclusion.

In concluding, the lecturer directed attention to a series of cases which had shown us the actual working of natural selection at the present time. He also explained that these cases were at present few in number, first, because they had not been searched for, but perhaps mainly because they only occur on a large scale at rather long intervals, when some great and rather rapid modification of the environment is taking place.

In the following paragraph he endeavoured to summarise the entire problem and its solution:—"It is only by continually keeping in our minds all the facts of nature which I have endeavoured, however imperfectly, to set before you, that we can possibly realise and comprehend the great problems presented by the 'World of Life'—its persistence in ever-changing but unchecked development throughout the geological ages, the exact adaptations of every species to it actual environment both inorganic and organic, and the exquisite forms of beauty and harmony in flower and fruit, in mammal and bird, in mollusc and in the infinitude of the insect-tribes; all of which have been brought into existence through the unknown but supremely marvellous powers of Life, in strict relation to that great law of Usefulness, which constitutes the fundamental principle of Darwinism."

LONG-DISTANCE TELEGRAPHY.

THE developments which have recently taken place in long-distance direct telegraphic working show that progress has been made in telegraphic transmission by wire as well as in wireless telegraphy. The direct transmission of public messages between London and India was put into operation last week, and messages were sent at the rate of forty words per minute between London and Karachi. Direct working with Calcutta, Bombay, and Madras has been successfully established, the experiment of direct transmission to the first-named centre being attempted for the first time last Saturday, when a world's record was established of about 7000 miles.

Direct Wheatstone working over the line between London and Teheran—a distance of 3748 miles—has been possible since the beginning of 1903, but no land line existed between Teheran and Karachi. This line has been recently erected by the Indo-European Department of the India Office, and was put into operation in November, 1907, bringing the total length of line—London to Karachi—up to 5532 miles. Wheatstone automatic transmission is used throughout the line, and many improvements in telegraphic instruments which have been introduced in recent years have been installed. One of the latest key-board perforators is the Kotyra, which is so arranged that the key-board is made to actuate three electromagnets so constructed that the necessary number of blows are communicated to the keys of a Wheatstone perforator. At each relay station a receiving apparatus is placed in circuit enabling the operator in charge to see how the signals are leaving that station, and any fault in regulation can be at once rectified.

The great advantage of being able to transmit direct messages over such distances is that, apart from the time saved and the consequent increase in the capacity of the line, greater accuracy is ensured owing to the fact that no intermediate handling takes place. Thus liability to error is reduced to a minimum. The importance of this will be understood when it is realised that 1600 messages per diem—97 per cent. of which are in code—are sent on the average over this line. The Indo-European Telegraph Company and the Telegraphic Department of the India Office have, with the cooperation of the Indian Government, achieved a great success, considering the enormous difficulties attendant upon a land line traversing every variety of country and exposed to all sorts of climatic conditions. J. L. M.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. H. F. Newall, F.R.S., has been elected a fellow of Trinity College. Mr. Newall has been engaged for many years in astrophysical research at the observatory, in connection with a large Equatorial presented to the University by his father. He was formerly an assistant to the Cavendish professor of physics, and demonstrator in the Cavendish Laboratory. He is at present assistant director of the Observatory, treasurer of the Cambridge Philosophical Society, and president of the Royal Astronomical Society. Mr. Newall, by his continuous generosity, has firmly established the study of astrophysics in the University, and to him the University owes a considerable debt of gratitude.

LONDON.—A course of eight lectures on national eugenics, in connection with the Galton Laboratory, will be given at University College on Tuesdays at 5 o'clock, beginning on February 23. The first lecture will be given by Prof. Karl Pearson, on "The Purport of the Science of Eugenics." On the four following Tuesdays the lectures will be given by Mr. D. Heron, and will deal with the following subjects:—methods of eugenic inquiry; transmission of physical characters in man; transmission of psychical characters in man; inheritance of disease and deformity. The course will be continued in the third term, beginning on May 4, when Miss E. Elderton will lecture on "Effects of Kinship in Marriage" and "Comparison of Heredity and Environmental Factors." Full par-

ticulars of the lectures can be obtained from the secretary of University College.

THE annual prize distribution and conversazione of the Northampton Polytechnic Institute, Clerkenwell, E.C., will be held on Friday and Saturday, February 5 and 6. The Earl of Halsbury, P.C., will distribute the prizes on February 5, and after the prize distribution the new buildings, which have been recently erected in the courtyard with funds provided by the London County Council, will be formally declared open. After the above ceremonies the whole of the laboratories, workshops, drawing offices, and studios of the institute will be on view in working order.

THE second international course for legal psychology and psychiatry will be held at Giessen (Grandduchy of Hesse), Germany, on April 13—18. The course will be under the direction of Prof. Sommer, with the cooperation of Profs. Mittermaier and Dannemann, of Giessen, and Prof. Aschaffenburg, of Cologne. All communications should be addressed to Dr. Sommer, professor of psychiatry, University of Giessen.

AN article by Prof. Fleming in *Engineering* for January 8 directs attention to the need for a revision of the syllabus for the B.Sc. degree in engineering at London University. It is contended that the syllabus now in force enables a candidate to obtain the degree without having undergone a systematic training in civil, mechanical, or electrical engineering, owing to the freedom of choice allowed, especially in the second or "B" group of subjects. The experience of several years has shown that a large number of candidates exercise their freedom of choice by taking the path of least resistance, and they do not, as a rule, select subjects which form complete and well-arranged courses of study. Subjects of minor importance have, to the majority of candidates, a wide popularity for examination purposes, and Prof. Fleming suggests that if university degrees are to possess, or to continue to possess, any importance in the engineering world, the courses of study must be framed solely with a view to equip students for their work in after life, and not for the immediate purpose of passing an examination.

WE have received a copy of the second series of papers published by the Department of Education of the Armstrong College, Newcastle-upon-Tyne. The special feature of the pamphlet is a very full account of an experiment of a novel character in training-college practice. As Prof. Mark R. Wright, the head of the department, points out, in ordinary school work there is a tendency for the relations between teachers and taught to become formal and artificial, and the motive of the experiment described in these pages was to determine how far a training-college camp could be made to obviate such tendency and to import humanising influences and greater cordiality into the work of education. Outdoor life and the study of nature under skilled guidance were among the distinguishing characteristics of the fortnight's life under canvas, and the results of the experiment appear to have been gratifying. The experiment is, we understand, to be repeated annually, and we hope it may be imitated by other training-college authorities. There can be no doubt that intelligent, well-planned experiments, followed by an impartial and correct account of the results obtained, will contribute more than any other expedient to the development and formulation of a science of education. These "papers" may be commended to the attention of students of educational problems.

THE report on the operations of the University of the Punjab for the year ending September 30, 1908, emphasises the contention, says the *Pioneer Mail*, that in Indian universities the arts side, which comprises exclusively literary courses, is patronised to the neglect of the scientific side of education. In the Punjab University there is no faculty either of engineering or of commerce. There is a faculty of science, but its examinations, compared with those of the faculty of arts, do not attract many candidates. Referring to the examinations of the two faculties held in 1908, it is pointed out by our contemporary that in the matriculation examination, whilst in the arts faculty there were 3408 candidates, of whom 1470 were successful, in the science faculty there were only 72, of whom 36 were successful. In the intermediate examination, whilst 697, of whom 308 were successful, appeared on the arts side, the number of those who appeared on the science side did not exceed 39, and of these 18 were successful. Whilst 315 appeared for the degree of Bachelor of Arts and 116 were successful, a much smaller number, of whom 5 were successful, competed for the degree of Bachelor of Science. As regards the master's degree in the two faculties, whilst 42 competed on the arts side, there were only 4 on the science side. The results on the science side were, however, better than those on the arts side.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, Received November 3, 1908.—"Reciprocal Innervation of Antagonistic Muscles. Thirteenth Note. The Antagonism between Reflex Inhibition and Reflex Excitation." By Prof. C. S. **Sherrington**, F.R.S.

In this paper the question is raised as to how reflex excitation and reflex inhibition are related one to another in their action on a reflex centre common to both of them. In the case of such antagonisms as the action of the vagus and accelerans on the heart and that of the vasodilatator and vasoconstrictor nerves on a vascular area, and that of depressor and excitatory asphyxial influences on the vasomotor centre, several observers have shown that the antagonism is a pseudo-antagonism rather than a real antagonism—that is, the one action interferes with the other by delaying it, but does not directly annul it or really abolish or counterbalance it.

The present paper brings experimental evidence that in reflex inhibition and reflex excitation playing upon a common centre we have two influences which are really in the strict sense antagonistic in that they behave one to another as two forces which act in opposite direction at the same point of application. The result is an algebraic summation of the effects obtainable from the two nerves—the excitatory afferent and the inhibitory afferent—singly. The individual effects of the two nerves fuse to a resultant. The two opposed nerves must have in the reflex centre a common locus of operation. There the antagonistic influences collide. This point of collision may lie at a synapse, in which case the opposed influences may be thought of as altering oppositely the permeability of the synaptic membrane. Or it may lie in the substance of a neurone, if so, probably in the motoneurone itself, and in that part of it which lies within the reflex centre. In either case the net change which results when the inhibitory and excitatory afferents are concurrently stimulated is an algebraic sum of the *plus* and *minus* effects producible by the two antagonistic nerves singly. Tracings illustrate the experimental results.

November 19, 1908.—"Measurement of Rotatory Dispersive Power in the Visible and Ultra-violet Regions of the Spectrum." By Dr. T. Martin **Lowry**.

In order to measure rotatory dispersive power in the visible region of the spectrum, the light from an arc formed between a pair of rotating metallic electrodes is concentrated by a lens on the widely opened slit of a constant-deviation spectroscope. An achromatic lens of 22-inch focus (displacing the telescope of the instrument) casts a magnified image of the slit on the polarising prisms of a triple-field polarimeter. The colour of the image can be varied by rotating the prism of the spectroscope; its maximum width for monochromatic illumination is determined by the openness of the spectrum and the efficiency of the dispersive system. Of the twenty-six wave-lengths employed, those shown in heavy type can be read with the full width of the aperture, the remainder as bands occupying one-third of its width; the yellow mercury doublet can be read as a single band or as two narrow separate lines:—

Li	**6708**	Na	**5893**	Tl	**5351** (flame spectra)
Hg	*5790*	*5769*	**5461**	**4359**	(enclosed arc)
Cd	**6438**	**5086**	**4800**	**4678**	
Cu	5782	5700	5219	5154	5105
	4705	4651	4587	4378	
Zn	**6364**	4811	4722	4680	
Ag	**5469**	**5209**			

A photographic method is also described which can be used throughout the visible and ultra-violet regions of the spectrum.

December 10, 1908.—"Results of Magnetic Observations at Stations on the Coasts of the British Isles, 1907." By Commander L. **Chetwynd**, R.N. Communicated by Rear-Admiral A. M. Field, R.N., F.R.S.

With a view to compare the values of secular change of declination, horizontal force, and inclination, at various stations on the coasts of the British Isles, with the values derived from the continuous records at Kew Observatory, observations have been made at certain stations selected from those occupied by Rücker and Thorpe during their magnetic survey for the epoch January 1, 1891.

The observers detailed to make the observations were Captain M. H. Smyth, R.N., H.M.S. *Research*; Captain W. Pudsey-Dawson, R.N., H.M.S. *Triton*; and Captain J. W. Combe, R.N., H.M. surveying vessel *Gladiator*. The stations selected were fairly distributed around the coasts, so that a mean of the results would represent the mean for the whole area embraced.

The observations have been reduced to the epoch January 1, 1907, by means of comparisons with the records at Kew Observatory. The resulting values of mean annual changes for the British Isles are as follows:—

	a 21-year period, 1886–1907	*b* 16-year period 1891–1907
(1) Declination...	$-\ 5'{\cdot}7$	$-\ 5'{\cdot}1$
(2) Horizontal force...	$+19\gamma$	$+18\gamma$
(3) Inclination	$-\ 1'{\cdot}6$	$-\ 1'{\cdot}4$
(4) Vertical force (excepting the results at Dublin and Tanera Mor)	—	-14γ

The mean annual changes of declination at Kew comparable with (1) *a* and *b* are respectively $5'{\cdot}2$ and $4'{\cdot}9$. Thus the mean for the British Isles during the 16-year period is $0'{\cdot}2$ greater than at Kew.

The mean horizontal force change appears to have been 3 γ less than at Kew. The mean inclination change during the 21-year period was $0'{\cdot}1$ less, and during the 16-year period $0'{\cdot}6$ less, than at Kew.

The mean vertical force change during the 16-year period has been 8 γ less than at Kew.

Diagrams showing the mean annual changes at Kew from 1889 to 1904 indicate that the declination change, which since 1894 has been decreasing in amount, is now increasing, and that the probable value at Kew for January 1, 1907, is $4'{\cdot}8$. For the whole of the British Isles, therefore, the mean value is assumed to be $5'$.

The annual increase of horizontal force continues to diminish, and is at the present time very small; there has been a very marked diminution during the last two years, and the annual increase may shortly become a decrease.

The annual change of inclination continues to decrease in amount, and is now $1'$ (nearly).

A comparison of the value of the mean annual change of declination at Kew, Greenwich, and Stonyhurst shows that during the period embracing Rücker and Thorpe's survey (1886–94) the change at Stonyhurst was considerably greater than at Kew and Greenwich, this being in accord with the results found by Rücker and Thorpe (that the secular change was greater in the north-west than at Kew).

Since the year 1894, however, the values have been in closer agreement, that at Stonyhurst being slightly less than at Kew. Thus it is indicated that the variations of secular change are not, over the area referred to, synchronous.

Comparisons of results of declination observations made at sea with those made on shore show considerable differences, and although the sea observations cannot be considered to the same degree of accuracy as the shore observations, the differences are in most cases outside the margin which might be assigned to this cause.

The results indicate that the values at sea are, off the east coast generally greater, and on the west coast generally less, than the corresponding values adduced from observations made on shore. It is intended to investigate this subject further.

Royal Meteorological Society, January 20.—Annual meeting.—Dr. H. R. Mill, president, in the chair.—Presidential address, Some aims and efforts of the society in its relation to the public and to meteorological science: Dr. **Mill**. In dealing with the subject-matter of meteorology, as of other sciences, there are two extreme points of view which appeal to opposite types of mind; these are the simply observational and the purely analytical, and it is one of the great advantages of a scientific society to bring representatives of the two types together, and to encourage mutual toleration and understanding. After referring to the activity of the society in the establishment of well-equipped and carefully inspected stations for accurate observations of meteorological phenomena, and to the work carried out by various special committees, the president proceeded to direct attention to two lines of usefulness open to the society at the present time. One is the correction of the impulsive sensationalism and anti-scientific spirit in meteorological matters of a certain section of the Press in this country, which no doubt faithfully reflects the somewhat muddled ideas of the careless public; of these he gave some striking instances. The other is the advance which has been made in meteorological science during the last few years, and the new opportunities it brings. He alluded to the popular errors which are current concerning published weather records, and the prejudicial effect of these on the meteorological departments maintained by many municipalities. He had heard of instances of reports being suppressed in order to "obviate misconceptions," and of instruments being moved in order to obtain more agreeable records. He deprecated the keenness of rivalry between health resorts claiming low rainfall, high sunshine, and small range of temperature, and pointed out that modern bacteriology had shown that dust, not rain, was the chief menace to public health. He went on to say that we now stand at an important point in the history of meteorology, which bids fair to expand in interest and importance in the twentieth century as chemistry did in the nineteenth, and from the same cause, the increasing necessity of applying its principles to practical ends. The point of view of the meteorologist to-day is different from that of fifty or even of twenty years ago. Then the only department in which much general interest could be expected was climatology—the study of the average conditions of the atmosphere at different places. Much remains to be done in that direction; but the main interest is being diverted from the study of the air 4 feet above the ground, on the study of which climatology has been based, to the vast expanse of the upper atmosphere miles above the abode of man. He believed that in a few years the practical needs of aviation will demand a far more exact knowledge than is now required of atmospheric circulation, of the relation of wind to gradient, of the disturbing influence of insolation on pressure, and especially of the nature and movements of cyclones and squalls, and these things becoming of practical importance, it will become worth while commercially to find the means for studying them. The position of meteorology now is not unlike that of oceanography before the necessity of laying cables led to the exact study of ocean depths, and it is to be expected that the flying machine will do for the study of the air what the cables did for the study of the sea.

Entomological Society, January 20.—Mr. C. O. Waterhouse, president, in the chair.—Presidential address, The claws of insects: C. O. **Waterhouse**. After briefly describing the various forms of insects' claws, which are classified as toothed, appendiculate, bifid, or pectinate, and having given examples of each, the president suggested as a subject for investigation, which he hoped entomologists would take up as a study, "Are these forms of claw merely the result of heredity without any special object, or is there evidence to show that the different forms are adapted to particular modes of life, in fact, have been developed to meet special needs?" He then proceeded to show by numerous examples that closely allied species often had dissimilar claws, that insects with quite different habits had the same form of claw, and that others with different forms of claw seemed to have the same habits. The question, therefore, appeared to be still an open one requiring careful investigation.

DUBLIN.

Royal Dublin Society, December 22, 1908.—Prof. A. F. Dixon in the chair.—The production of ammonia from atmospheric nitrogen by means of peat: Dr. H. C. **Woltereck.** The author showed that by the various processes known only about one-third of the nitrogen contained in the peat can be recovered. The evolution of the synthesis from the use of hydrogen and nitrogen with reduced iron, down to coke and peat, with air and steam was described, and the analogy of this process with that using iron was definitely proved by the use of sugar carbon, free from nitrogen, thus demonstrating the indisputable cooperation of atmospheric nitrogen.—The pollination of certain species of Dendrobium: Dr. A. F. G. **Kerr.** An arrangement often found in the flowers of the section Eu-dendrobium is described, whereby the elasticity of the filament causes the anther to be jerked down and to block the passage past the stigma to the nectary as the visiting insect withdraws from the flower. By this mechanism only the first visitor can pollinate the stigma. The pollinia are only discharged as the visitor leaves, consequently it is evident that cross-pollination only can occur. The mechanism is quite different from that described by Darwin in *D. chrysanthum*, which, he believed, aided self-pollination. Experiments on many specimens of sixteen species of Eu-dendrobium in their native habitats showed that self-pollination was effective in only 8 per cent., and cross-pollination in 100 per cent. Modifications of the mechanism described allowing self-pollination are found in the species which contribute this 8 per cent. The paper also contains descriptions of arrangements obtaining in other Dendrobia which favour or oppose self-pollination, as well as records of experiments on these species of self- and cross-pollination. All the observations were carried out in the natural localities.—The absorption of water by seeds: W. R. G. **Atkins.** An examination of the behaviour of seeds of *Phaseolus vulgaris* and *Lathyrus odoratus*, both living and dead, in water and salt solutions, shows that no semi-permeable membrane exists in them until after germination, when the protoplasm of the cells acts as such. The evolution of CO_2 may be detected within two hours after moistening air-dried seeds, whether they are living or killed by chloroform.

PARIS.

Academy of Sciences, January 18.—M. Bouchard in the chair.—Some applications of the method of M. Fredholm: H. **Poincaré.**—A general method of preparation of the trialkylacetic acids: A. **Haller** and Ed. **Bauer.** Ketones of the type $C_6H_5.CO.C.R_1R_2R_3$ were dissolved in benzene and heated with sodium amide, and split up quantitatively into benzene and the amide of the trialkylacetic acid,

$$(R_1R_2R_3)C.CO.NH_2;$$

the latter, treated with nitrosyl sulphate, gives the corresponding acid, $C(R_1R_2R_3).CO.OH$. The method is general, and has been applied to the preparation of pivalic, dimethylethylacetic, dimethylpropylacetic, methyldiethylacetic, triethylacetic, and methylethylpropyl acetic acids, as well as the corresponding amides. The distinguishing physical properties of these compounds are given.—A hæmogregarian of *Tupinambis teguixin*: A. **Laveran** and M. **Salimbeni.** This organism appears to constitute a new species, for which the name *H. tupinambis* is proposed. The paper is accompanied by six diagrams showing various stages of development.—An epithelium with striated muscular fibres: F. **Henneguy.** A demonstration of the existence of striated muscular fibrillæ in the walls of the epithelial cells of the digestive tubes of *Alcyonidium hirsutum* and *Bugula alveolata*.—An apparatus for recording the absolute acceleration of seismic movements: G. **Lippmann.**—The evolution of the Tertiary mammals: the importance of migrations. The Pliocene epoch: Charles **Depéret.**—M. W. Kilian was elected a correspondant in the section of mineralogy in the place of the late M. Peron.—Discussion of the micrometric measurements made at the Observatory of Lyons during the eclipse of June 28, 1908: F. **Merlin.**—A zenithal photographic telescope: A. de la Baume **Pluvinel.** The instrument is designed to determine the astronomical coordinates of the place where it is set up. The latitude is deduced from the zenithal distance of a star measured on a negative, the longitude from a knowledge of the time at which the star occupies, on the negative, a certain position corresponding to the passage through the meridian.—A problem concerning geodesic lines: Jules **Drach.**—A generalisation of a theorem of Jacobi: W. **Stekloff.**—The theory of continuous functions: Maurice **Fréchet.**—Differential equations the general integral of which is uniform: J. **Chazy.**—Some optical and magneto-optical phenomena in crystals at low temperatures: Jean **Becquerel.** A discussion of the causes of the differences between the conclusions of the author and those of MM. H. du Bois and Elias.—A characteristic property of a hexagonal network of small magnets: L. **de la Rive** and Ch. Eug. **Guye.**—An optical arrangement for varying the lighting of a surface according to a law determined in advance: Th. **Guilloz.**—The rapid preparation of calcium phosphide for making hydrogen phosphide: C. **Matignon** and R. **Trannoy.** Dried calcium phosphate is heated with aluminium powder, and the mixture started off at a dull red heat. The product is a mixture of calcium phosphide and alumina, which on treatment with water gives a nearly pure non-inflammable phosphoretted hydrogen. The only impurity of the gas obtained in this way is hydrogen, which may be present up to 3 per cent.—The action of sulphur chloride, S_2Cl_2, on the metallic oxides: F. **Bourion.** It has been found that in certain cases in which the method of treating the oxide with chlorine and sulphur chloride fails, the latter alone gives a good yield of the anhydrous chloride. Amongst other chlorides prepared in this way, that of samarium is noteworthy, as of all the oxides of the cerium group this is the most difficult to transform into chloride.—Colour reactions of dioxyacetone: G. **Denigès.**—The nature of the bromacetamide of Hofmann: Maurice **François.** This bromine derivative can be prepared by the evaporation of a mixture of hypobromous acid and acetamide. On this account the author considers its composition to be $CH_3.CO.NH_2.Br.OH$.—Researches on the products of saponification of dioxalsuccinic ester. Isopyromucic acid: E. E. **Blaise** and H. **Gault.**—The preparation of aldehydes and anhydrides of acids: A. **Béhal.** Benzylidene chloride, heated with acetic acid, reacts according to the equation

$$C_6H_5.CHCl_2+2CH_3.CO_2H=2HCl+C_6H_5CH:O+(CH_3CO)_2O.$$

The presence of certain salts, such as chloride of cobalt, assists the reaction.—The artificial oxydases and peroxydases: M. **Martinand.**—The successive induction of coloured images after a very strong stimulation of the retina, and the classic theories of vision: Romuald **Minkiewicz.**—X-rays of high penetration obtained by filtration. Their advantage in radio-therapy for the treatment of deep-seated tumours: H. **Guilleminot.** The filtration of the rays through 5 mm. of aluminium is recommended; the issuing rays will be approximately "monochromatic." Although the absolute quantity transmitted will be much reduced, necessitating a longer exposure, the percentage absorption in the soft tissues will be small, and deep-seated tumours can be more effectively reached by the rays.—The identification of revolver bullets: V. **Balthazard.** The problem was to prove whether certain bullets found on the floor had traversed the arm of the wounded person. It is shown that after traversing a cloth material, characteristic markings are produced on the leaden bullet, and these are not obliterated by the subsequent passage through flesh, provided a bone is not encountered. It is even possible to identify the nature of the garment through which the bullet has passed by a careful examination of the markings on the bullet.—Sexual reproduction in the Actinocephalids: P. **Léger** and O. **Duboscq.**—Some Sertulariidæ in the British Museum collection: Armand **Billard.**—Biological researches on the conditions of viviparity and larval life of *Glossina palpalis*: E. **Roubaud.**—New observations on the habits of the asparagus fly (*Platyparea poeciloptera*) in the neighbourhood of Paris. The insufficiency of the method of destruction now in use: P. **Lesne.**—A possible interpretation of the waves of the principal phase of seismograms: M. de Montessus **de Ballore.**—The earthquake of December 28, 1908, recorded at the Fabra Observatory, Barcelona: J. Comas **Sola.**

NEW SOUTH WALES.

Linnean Society, November 25, 1908. Mr. Henry Deane, vice-president, in the chair.—The *rôle* of nitrogen and its compounds in plant-metabolism, part i., historical: Dr. J. M. **Petrie**. A summary of the recent advances made in the study of proteins and their antecedents in the plant. An account is given of the nitrogen compounds which occur in seeds, and the modern views of their function in germination.—The *rôle* of nitrogen and its compounds in plant-metabolism, part ii.: Dr. J. M. **Petrie**. Deals with the non-protein nitrogen compounds of seeds, and gives the results obtained from the analyses of the seeds of thirty different plants. Previous investigators have seldom found less than 90 per cent. of the total nitrogen existing as protein, whereas the author finds as much as 45 per cent. of non-protein nitrogen compounds in ripe Acacia seeds. Exact descriptions of the methods employed are also given.—Contribution to a knowledge of Australian Hirudinea, part ii.: E. J. **Goddard**. A new genus is proposed for a leech from a fresh-water pool at Oberon, New South Wales.—Contribution to a knowledge of Australian Oligochæta, part ii.: E. J. **Goddard**. Another phreodrilid worm, from pools on the Mt. Wellington plateau, Tasmania, is described. It is of interest because its Tasmanian habitat completes the circuit of distribution of the family—from South America to New South Wales.—Illustrations of polycotyledony in the genus Persoonia (N.O. Proteaceæ): J. J. **Fletcher**. In 1882, as the result of his examination of the fruits of twenty-three out of a total of sixty-one described species of Persoonia, the late Baron von Mueller was able to announce that the embryos of nineteen of them were polycotyledonous. The object of the present paper is to supplement the Baron's observations in so far as these relate to the species of Persoonia to be found in the neighbourhood of Sydney and on the Blue Mountains, from a study of seedlings, and whenever it was possible of a considerable number of them. The cotyledons of about 700 seedlings, representing ten species, four of which are not in the Baron's list, and, in addition, the embryos of two species of which seedlings were not procurable, one of which is not in the Baron's list, were examined. The only seedlings or embryos with two cotyledons met with were those of *P. ferruginea*, Sm. Not only is the number of cotyledons in all the other species examined inconstant, but about 10 per cent. of the total number of seedlings were found to possess one, occasionally two, or rarely three notched, bifid, or bipartite cotyledonary members; some of these possibly may have been cases of connate cotyledons.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 28.

ROYAL SOCIETY, at 4.30.—The Action of the Venom of *Sepedon haemachates* of South Africa: Sir Thomas R. Fraser, F.R.S., and Dr. J. A. Gunn.—The Colours and Pigments of Flowers with Special Reference to Genetics: Miss M. Wheldale.—The Variations in the Pressure and Composition of the Blood in Cholera; and their Bearing on the Success of Hypertonic Saline Transfusion in its Treatment: Prof. Leonard Rogers, I.M.S.—The British Freshwater Phytoplankton, with Special Reference to the Desmid-plankton and the Distribution of British Desmids: W. West and G. S. West.—The Selective Permeability of the Coverings of the Seeds of *Hordeum vulgare*: Prof. Adrian J. Brown. The Origin of Osmotic Effects. II. Differential Septa: Prof. H. E. Armstrong, F.R.S.

ROYAL INSTITUTION, at 3.—Mysteries of Metals: Prof. J. O. Arnold.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Parallel Operation of Alternators: Dr. E. Rosenberg.

ROYAL SOCIETY OF ARTS, at 4.30.—Some Phases of Hinduism: Krishna Gobinda Gupta.

FRIDAY, JANUARY 29.

ROYAL INSTITUTION, at 9.—Improvements in Production and Application of Gun-cotton and Nitro-glycerine: Sir Frederick L. Nathan.

SATURDAY, JANUARY 30.

ROYAL INSTITUTION, at 3.—Sight and Seeing: Sir Hubert von Herkomer.

ESSEX FIELD CLUB, at 6 (at Essex Museum of Natural History, Romford Road, Stratford).—Subsidence of Eastern England and Adjacent Areas: W. H. Dalton.—Some Notes on "Moorlog," a Peaty Deposit dredged up in the North Sea: H. Whitehead and H. H. Goodchild.

MONDAY, FEBRUARY 1.

ROYAL SOCIETY OF ARTS, at 8.—Electric Power Supply: G. L. Addenbrooke.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Manufacture of Nitrocellulose: Sir Frederick Nathan.

TUESDAY, FEBRUARY 2.

ROYAL INSTITUTION, at 3.—The Architectural and Sculptural Antiquities of India: Prof. A. A. Macdonell.

ZOOLOGICAL SOCIETY, at 8.30.—Notes on the Fauna of Christmas Island: Dr. C. W. Andrews, F.R.S.—Report on the Pathological Observations at the Society's Gardens during 1908: Dr. H. G. Plimmer.—Preliminary Account of the Life-history of the Leaf-insect, *Phyllium crurifolium*, Serv.: H. S. Leigh.—The Mammals of Matabeleland: E. C. Chubb.

ROYAL SOCIETY OF ARTS, at 4.30.—The Production of Wheat in the British Empire: Albert E. Humphries.

INSTITUTION OF CIVIL ENGINEERS, at 8.—On Heat-flow and Temperature-distribution in the Gas-engine: Prof. B. Hopkinson.

WEDNESDAY, FEBRUARY 3.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The use of Quartz Combustion Tubes especially for the Direct Determination of Carbon in Steel: B. Blount and A. G. Levy.—The Composition and Analysis of Chocolate: P. A. Ellis Richards, C. H. Cribb, and N. P. Booth.—Note on some Commercial Samples of Monobrombenzene: J. H. Coste.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, FEBRUARY 4.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Electricity of Rain and its Origin in Thunderstorms: Dr. George C. Simpson.—The Effect of Pressure upon Arc Spectra, No. 3, Silver. λ 4000–λ 4600: W. G. Duffield.—The Tension of Metallic Films deposited by Electrolysis: G. Gerald Stoney.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—The Stability of Arches: Prof. Henry Adams.

LINNEAN SOCIETY, at 8.—On *Fucus spiralis*, Linn.: Dr. F. Börgesen.—Economy of *Ichneumon manifestator*, Linn.: C. Morley.—On the Polyzoa of Madeira: Rev. Canon Norman, F.R.S.

RÖNTGEN SOCIETY, at 8.15.—The Transport of Ions: Dr. Howard Pirie.

FRIDAY, FEBRUARY 5.

ROYAL INSTITUTION, at 9.—The Influence of Superstition on the Growth of Institutions: Prof. J. G. Frazer.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design and Construction of Docks: Sir Whately Eliot.

CONTENTS.

THURSDAY, FEBRUARY 4, 1909.

A SURGEON AND A PATHOLOGIST ON CANCER.

(1) *The Natural History of Cancer, with Special Reference to its Causation and Prevention.* By W. Roger Williams. Pp. xiv+519. (London: W. Heinemann, 1908.) Price 21s.

(2) *Lectures on the Pathology of Cancer.* By Dr. Charles Powell White, Pilkington Cancer Research Fellow. Pp. vii+83; 33 figures. (Manchester: University Press, 1908.) Price 3s. 6d. net.

(1) THE author of this volume has contributed extensively to the literature of cancer from 1882 onwards. Both from the scope and from the duration of his inquiries into the various manifestations of this disease in man, he would certainly seem to have earned the right to express opinions to which other students of the subject must give consideration. The volume contains an immense amount of material, partly the harvest of the author's own experience and partly culled from the literature of the subject. This rich collection of facts, with complete references to the original sources, while evidence of the wide reading of Mr. Williams, must also make the volume valuable in the limited spheres of which it treats as a book of reference for workers on cancer.

Unfortunately it has not been the author's desire to make the compilation and digest of much of the literature of cancer the main purpose of his book; indeed, in this field he has been forestalled by a masterly digest of the literature, which is at the same time an admirable history of the advance in knowledge of cancer, by Dr. Jacob Wolff, "Die Lehre von der Krebskrankheit" (Jena: Fischer, 1907). Rather would the author direct attention to what he is pleased to stigmatise as "the extraordinary concatenation of blunders with which the history of the experimental study of cancer is cumbered," and to the "stagnation of comparative pathology." These serious charges are made because Mr. Williams's "work has hitherto received no recognition from contemporary pathologists occupied with various will o' the wisps," and because his voice has been crying in the wilderness since 1888, when, by the publication of "The Principles of Cancer and Tumour Formation," he attempted to "repair Virchow's error, by laying the foundation of a modified cellular pathology, in harmony with modern biology."

The author is at his best when dealing with the clinical course and the pathology of the disease in man, of which, as a surgeon, he has ripe experience; but most of what he has to say of value appeared in "The Twentieth Century Practice of Medicine," vol. xvii., 1899. It is to be regretted that in the fields of general biology he exhibits that combination of imperfect knowledge and intolerance of the conclusions of workers in spheres outside his own, which, only too frequently, have been features of the contributions of a few other authors who during the past three years have settled the problems of cancer to their own satisfaction in almost equally bulky volumes.

Mr. Williams is obviously not equipped to deal with the natural history of cancer in the wider sense. Analogies between lumps of tissue in the higher plants and in the higher animals have no dangers for him in a chapter on "Tumours in Vegetable Organisms," at the end of which he refers the Acari to the order Insecta. On p. 205 he writes:—

"It has recently been demonstrated by Boveri and Delage, that denucleated eggs of the sea urchin can be fertilised, when they give rise to the normal gastrulæ and larvæ; so that . . . the nucleus is not the sole vehicle of heredity."

Of course, Boveri's experiments led to quite the contrary conclusion. They demonstrated that the gastrulæ had the characters of the strange species introducing the male nucleus. Mr. Williams's prejudice in favour of his own case is well illustrated by his allusion to Darwin and Haeckel as "the great lieutenants" of Herbert Spencer, and by his bald statement (p. 357), "I also believe that acquired characters are hereditable." "The phenomena of parthenogenesis are of much interest, as representing a transition from sexual to asexual reproduction," is another positive statement of a dubious validity (p. 207). His main argument is that the frequency of cancer goes hand in hand with the average well-being. The inhabitants of Norway—among whom the death-rate from cancer is about the highest in Europe—are *therefore* pictured as the best nourished in Europe. Any Norwegian or Swede would have informed the author that his assumption is erroneous. Referring to the frequency of cancer of the skin of the abdomen in Kashmir (p. 36), where a charcoal oven is worn round the waist, he asserts that "the disease is probably more akin to keloid than to cancer, and, like the former, it is probably due to microbic infection." As a matter of fact, the disease is well known to be cancer of the skin, to form secondary growths in the adjacent lymph-glands, and to follow prolonged chronic irritation.

These and many equally erroneous dogmatic statements, together with the violence of his language when referring to work—biological, pathological, statistical and experimental—incompatible with the views Mr. Williams holds, show that he is unable to interpret his facts without prejudice. It is not surprising, therefore, to find that many of the major problems of cancer which still await solution are, for the author, matters no longer admitting of discussion. Indeed, in his preface he claims:—

"I have devised a new method of cancer research—which may be called synthetic—whereby I have shown that there are modes of life, various habits and so forth which tend to prevent the incidence of cancer almost entirely in healthy stocks, and greatly to reduce its ravages even among the hereditarily disposed."

The volume contains not a particle of evidence to justify this claim, which is all the more deplorable in that the author goes out of his way time and time

again to pour ridicule on the reasonably substantiated claims of other workers to have made some slow progress by the application of the experimental method, but who, more modest than himself, still remain *non magistri sed discipuli naturae* in regard to cancer.

(2) Dr. Powell White's volume is in many respects an antithesis to that of Mr. Roger Williams. A pathologist by profession, his aims and methods are entirely different. The volume does not profess to contain the whole pathology of cancer, and it is a model of scientific self-restraint. Unlike Mr. Williams, Dr. White extends a whole-hearted welcome to recent experimental work. In four chapters the author covers in simple language much that is of main interest in the present phase of investigation of cancer, the study of which he rightly insists may not be separated from that of tumours generally. To this end he classifies tumours according to their histological structure and relation to normal tissues, and dismisses a classification based upon embryological conceptions as unscientific and useless. He then proceeds to discuss the rudiment of origin, the mode of growth and extension, the clinical features, and the relations of cancer to organisms attacked. In the latter connection it is pointed out that in studying questions of metabolism in individuals naturally attacked, it is difficult to separate the effects of the cancer *per se* from those due to the disturbance of the organ affected. The author is no doubt aware that when cancer is implanted into normal animals this complication is got rid of, and the effects of cancer *per se* obtained pure. Mr. Roger Williams and Dr. Powell White agree that there does not appear to be any specific cancer toxin, and in conformity with modern conceptions "cachexia," or wasting, is regarded as a secondary accidental consequence, and not as a necessary antecedent or concomitant constitutional condition. Original and suggestive work is recorded on the occurrence of cholesterin, fatty, and other crystals in cancer and in the adrenal cortex, and it is hinted that cholesterin plays some part in the regulation of cell proliferation.

The longest chapter in the book is devoted to causation. The evidence for and against extrinsic and intrinsic causation is discussed. A congenital origin is discarded, and a parasitic causation rejected as being entertained mostly by surgeons and bacteriologists who do not appreciate the pathological and biological difficulties which the hypothesis involves, and because, while its upholders never think it necessary to answer the criticisms against it, they continue to bring forward the same old arguments in its favour. This may be too sweeping a criticism of all the work done on the hypothesis that cancer might be a parasitic disease, for, although negative, this work certainly cleared the air, and those who have participated in it have done perhaps more to prove one another wrong than many pathologists who have persistently played the part of scoffing spectators. Still, we entirely agree with Dr. Powell White that the term parasitism can be applied only to the biological behaviour of the cancer cell itself; any further analogy with the processes of known forms of infective disease is certainly erroneous.

The author considers that extrinsic factors long known to play a part in the causation of cancer are adjuvant, and not essential, factors, and in defining the intrinsic causative factors he comes to the conclusion that a tumour arises from a disturbance of a position of unstable equilibrium between the proliferative forces within the cell and the antagonistic influences of the neighbouring cells. In short, the author seeks his explanation vaguely in the continued removal or diminution of the influences which restrain proliferation, in a disturbance of what is defined as "physiological equilibrium." The phrase physiological equilibrium, when applied to the phenomena of cell life, is, however, just one of those phrases which, while appearing to define something, really defines nothing. It is merely a vague re-statement of the problem, and disregards the fact that the cell is really a very complex mechanism of the component parts of which and their inter-relations we are continually learning more. Dr. White alludes to the progress that is being made by the experimental study of cancer in mice, and incorporates many of the results as bearing upon cancer in man. Now that it is possible to study the life-history of the cancer-cell experimentally, we may hope that ere long Dr. Powell White's vague explanation may be replaced by some more precise definition of the mechanism responsible for the ceaseless proliferation of cancerous cells, in regard to which, and its relations to constitutional conditions of the body, already much that is new is being learned. The volume, which is the outcome of work generously endowed by Mrs. Pilkington and encouraged by Prof. Lorrain Smith, is well illustrated with statistical charts and photomicrographs, and its perusal must prove profitable to all who wish to be brought up to date in the biology of cancer.

E. F. B.

MAN'S ANCESTRY.

Unsere Ahnenreihe (Progonotaxis Hominis)—kritische Studien über phyletische Anthropologie (Festschrift zur 350-jährigen Jubelfeier der Thüringer Universität Jena und der damit verbundenen Übergabe des phyletischen Museums am 30 Juli, 1908). By Ernst Haeckel. Pp. iv+58; 6 plates. (Jena: Gustav Fischer, 1908.) Price 7 marks.

DURING the last four decades Prof. Haeckel has so often sketched a hypothetical genealogical tree representing the series of man's supposed ancestors, stretching right back to the remote Protozoa, that his name as the author of a treatise bearing the title at the head of this column will convey to most readers a very precise idea of the general nature and scope of the work.

The book, in fact, is a new edition of the familiar story of man's "phylogeny," brought up to date by the incorporation of many of the results of recent morphological and anthropological research, such, for example, as Semon's, Schwalbe's and Klaatsch's work. That it is embellished with a rich profusion of characteristic new terms is not surprising, when

we remember that Haeckel has always been pre-eminently the godfather of the nomenclature of phylogeny.

Turning directly to his "phylema primatum," which is the main theme of the work, he believes that even in Cretaceous times there was a succession of small "mallotheria" (primitive placenta-bearing mammals or prochoriata), from the earliest of which the ancestors of the Marsupialia were derived, while the later members of the series became the progenitors of the Prosimiæ—the Lemuravida. The facts elucidated by the study of the comparative anatomy and embryology of the apes favour the hypothesis that the earliest (Oligocene or Miocene) platyrrhine monkeys constitute the connecting link between the Eocene Prosimiæ—Lemuravida—and the catarrhine phylum. He speaks of the phyletic unity of the latter (catarrhine phylum), and looks upon man as its highest branch. His succession of catarrhine ancestors of *Homo sapiens* consists of (1) the oldest cynocephali (Papiomorpha), represented to-day by such forms as the baboon; (2) the later cynocephali (Presbytomorpha), such as Nasalis; (3) the oldest man-like apes, such as the gibbons; (4) the later man-like apes, such as the orang and chimpanzee; (5) ape-men (*Pithecanthropus erectus*); and (6) primitive man (*Homo primigenius*).

He disarms the obvious criticism, which most zoologists will make of such a work as this, by repeating the oft-expressed assurance that his "suggestions regarding the phylogeny of man (and their obvious expression in the form of a genealogical tree) are not to be regarded as dogmatic axioms, but rather as *heuristic hypotheses*, intended merely to point the way in a field of research, which is as difficult and obscure as it is interesting and full of significance."

He has a considerable measure of justification for his claim that, in the great progress of anthropological knowledge in recent times, many statements regarding man's ancestry, which he put forward as little more than mere speculations forty years ago, have now been proved to be demonstrable facts.

The book contains a series of excellent illustrations of a cranium of *Homo sapiens*, compared with those of *Homo palinander* (an aboriginal Australian), a chimpanzee, a gibbon and a mandrill, and also a series of three corresponding stages in the embryonic development of nine different mammals.

G. Elliot Smith.

AN ATLAS OF GEOGRAPHICAL EXERCISES.

Practical Exercises in Physical Geography. By Prof. W. M. Davis. Pp. xii + 148; atlas of 45 plates. (Boston and London: Ginn and Co., 1908.) Price *3s. 6d.*

The laboratory steadily replaces the lecture room. The use of laboratory methods in elementary education has at length affected geography, and the former inadequate school exercises are being replaced by others over which the students must think for themselves. To help this change, Prof. W. M. Davis, the chief American prophet in the reform of geographical teaching, has designed an atlas of geographical exercises, accompanied by an explanatory text-book, and based upon his well-known geographical cycle. The atlas consists of forty-five plates, including at the end a few topographical maps of actual places, the usual charts to show the distribution of temperature, winds, and ocean currents, and six maps that give the outlines of each of the continents except Australia. The rest of the plates are ideal maps and sketches, which show the development of valleys, the growth of coasts and coastal plains, the characters of plateaus, the formation of residual mountains by denudation, and the structure of volcanoes. The sketch-maps all teach their lesson simply; there are not the irrelevant details with which Nature usually confuses her illustrations. A page or two of fancy pictures and maps are now inserted in most elementary atlases, but they merely illustrate geographical terms. Prof. Davis adopts this diagrammatic method for more advanced work, and his series of carefully planned exercises brings into due prominence the fundamental conceptions of physical geography. The maps offer excellent geographical exercises, and should be most useful where adequate time is devoted to geography.

Prof. Davis in his preface compares the use of ordinary maps for the first lessons on physical geography, to teaching elementary arithmetic from the books of a large commercial establishment. But this very comparison suggests a doubt whether these exercises could be widely adopted in British schools. Arithmetic is very unpopular with many school children, because they are not attracted by its logical progress, and they are discouraged by the apparent remoteness of its rules from the affairs of life. The effort is therefore made to teach arithmetic by the use of necessary every-day calculations, of which children can realise the practical value. Prof. Davis's system sacrifices the one advantage which ordinary geography shares with technical over purely academic education. To work through the whole of the exercises given in this book would occupy all the time allowed for geography in many elementary schools. The students would leave well prepared for the intelligent interpretation of maps, but they would not know the ordinary facts of political geography; whereas the study of actual instances, especially of local examples that can be checked by field observations, gives the children a keener interest in their work, an equally sound grasp of principles, and a store of useful facts indelibly impressed upon their minds.

In countries where school time is not used up by Latin and Greek, where modern languages are less important than they are in Europe, and public interest in education is not confined to the question of religious instruction, there may be time for students both to learn the geographical principles from such exercises as those of Prof. Davis, and subsequently to learn the necessary stock of facts. But as education is conducted in this country, the amount of time usually devoted to geography is so small that it is doubtful whether sufficient could be spared for Prof. Davis's exercises, though it is to be hoped that teachers will study them, and thus benefit by the last of his many contributions that have given life to geographical education.

J. W. G.

GRAPHICAL HYDRAULICS.

Water Pipe and Sewer Discharge Diagrams. By T. C. Ekin. Pp. 21. (London: Archibald Constable and Co., Ltd., 1908.) Price 12s. 6d. net.

OF all empirical formulæ devised for the solution of practical problems in natural science, hydraulic formulæ are perhaps the most involved and complex, and of all hydraulic formulæ it is doubtful whether there be a more formidable expression than the coefficient in Ganguillet and Kutter's formula for the flow of water in pipes and channels.

The general expression, and that which is now commonly recognised as furnishing the most trustworthy basis for the estimation of current velocity in such cases, is the equation devised by Chezy towards the close of the eighteenth century, viz. $V = C\sqrt{RS}$, involving the hydraulic mean depth (R) and the sine of the slope (S) in conjunction with a coefficient C.

As determined by the classical researches of Ganguillet and Kutter (the formula is more generally associated with the name of the latter only of the two eminent Swiss experimentalists), the coefficient takes the form:—

$$C = \frac{a + \frac{l}{n} + \frac{m}{S}}{1 + \left(a + \frac{m}{S}\right)\frac{n}{\sqrt{R}}}$$

in which a, l, and m are respectively in English units, 41·660475, 1·811325, and 0·0028075, and n is a variable depending upon the degree of roughness of the surface.

The labour involved in working out casually, and as necessity arises, a particular value from so cumbrous an expression is sufficiently obvious, and it is not surprising that a number of attempts have been made to supply some ready solution applicable to different data by the construction of curves and graphical diagrams.

The author points out that hitherto such curves have not dealt with gradients exceeding 5 per 1000, and that steeper gradients are often required. He has, therefore, worked out a series of curves giving the discharges of pipes ranging from 3 to 48 inches in diameter, and the velocities, when running full, on gradients from 5·28 feet per mile, 1 in 1000 or 1 per 1000, up to 79·2 feet per mile, 1 in 66·6 or 15 per 1000, and embodied the results in four large diagrams in which each discharge curve is the result of twenty-two separate calculations, and each velocity curve has been calculated for each point in which it cuts the discharge curve.

These diagrams are not strictly derived from Kutter's original formula, but from Flynn's modified statement of it, with n and S (=0·001) taken as constant throughout the series of curves, and $\sqrt{R}$ varying with each diameter of pipe. The coefficient of roughness of surface (n) has been fixed at 0·013, as most applicable to practical work under ordinary conditions. There are a number of cases, however, in which pipes calculated with this value give results either too large or too small, and with the view of making the diagrams apply to several coefficients of roughness, the author has calculated a series of constants, embodied in a separate table. There are six tables in all, forming an appendix, yielding detailed information respecting pipe flow and hydraulic data generally.

The compilation should prove of great utility to those engaged upon problems of water supply, sewage disposal, and practical problems of a kindred nature.

BRITISH OAK GALLS.

British Oak Galls. By E. T. Connold. Pp. xviii+169; 68 plates. (London: Adlard and Son, 1908.) Price 10s. 6d. net.

MR. E. T. CONNOLD has already given us a very valuable work on "British Vegetable Galls," but in that work, as the author states in the preface, the galls of the oak are not included, as he intended to publish a separate book dealing with them. This book has now appeared, and in every way it comes up to the standard of the larger work. A great feature of the book is the many life-like and excellently reproduced photographs of actual specimens of galls.

The oak is the abode of some five hundred different species of insects and other animals which subsist mainly on the leaves. Some are parasitic on the larvæ of the gall makers, and others are inquilines, which subsist on the tissues of the galls.

In his introduction the author touches upon some historical matters, and in chapter i. several very interesting and at present not fully understood phenomena in connection with the formation and colours of galls are discussed. Chapter ii., which deals with the characteristics of oak-gall growth, such as position, duration of growth, variations in shape, size and colour, &c., is also a very interesting chapter to the student of oak galls.

Chapters iii. and iv. deal respectively with the numerical aspect of oak galls and the Cynipidæ affecting the oak. The latter chapter is intended to present in a concise form such information as may be necessary for the collector or student who may not have ready access to other books which deal with these interesting and remarkable insects.

Chapter v. gives a short description of the genus Quercus, and especially of the British oak. In chapter vi. many useful hints on the collecting and mounting of oak galls are given. The rest of the book deals individually with the various species which cause oak galls. A synoptical table is given, also a table of the months in which the galls illustrated in the book may be found. A list of mid-European oak galls, with brief characteristics and position the gall occupies on the tree, is added, and will prove a great help to many. A useful index is also included.

This volume, the author tells us, is the outcome of fifteen years' study and practical research in the field. He is glad to say that he has been able to describe several galls not mentioned in any other English publication. Still, in spite of this great amount of time and study, the author does not claim completeness for his work. In the preface he says:—

"There is much more to be ascertained concerning the growth of oak galls, and one purpose of the

following pages will have been accomplished if they are the means of inspiring somebody to further unfold the subject."

The volume is certainly a very welcome addition to the literature, and can be warmly recommended to those interested in insect life, as well as to proprietors, foresters and all others interested in the growth of the British oak.

PRACTICAL ASTRONOMY.

Cours d'Astronomie. By H. Andoyer. Second part. Astronomie Pratique. Pp. 304. (Paris: A. Herman and Sons, 1909.) Price 10 francs.

To provide anything like a complete account of the methods of instrumental astronomy, whilst keeping the work within limits suitable for a course of university lectures, is not a practicable task. The second part of Prof. Andoyer's "Cours d'Astronomie" is much more bulky than the first part (which was devoted to theoretical astronomy), yet there is everywhere evidence that the author has been harassed by want of space, and is obliged to omit details which are often of the highest practical importance. He himself is keenly sensible of this limitation; again and again throughout the work he repeats that his treatment must be confined to a general indication of the methods, without entering into details.

The point of view of the work is thus necessarily academic, and differs somewhat from that of the practical observer; nevertheless, in the descriptions of instruments and accessories much interesting practical detail is given, which is not usually found in astronomical text-books. It is clear that great care has been taken that all such information should be trustworthy; in fact, the precision and accuracy which distinguished the first part of the course are again noticeable in this part. We may, however, point out one or two questionable passages; it is stated that the chronographic method is only used for meridian observations made at observatories (p. 63). It is difficult to understand why the author should have supposed that the method is thus limited; it is not so in practice. Again, we read that in determining differences of longitude of the great observatories, in spite of all precautions, and in spite of the skill of observers, "on est loin de pouvoir répondre du dixième de seconde de temps." Prof. Andoyer must have been misled into this generalisation through some exceptional discordances in one or two of the classical determinations of longitude. In recent determinations a much greater accuracy is normally attained.

The first part of the book deals with such subjects as interpolation, the theory of errors, and the method of least squares. Common accessory apparatus, including the graduated circle, micrometer and spirit-level, is next thoroughly discussed. Three instruments are selected for specially detailed treatment; these are the theodolite, the equatorial, and the transit circle. The theodolite is probably chosen because it is likely to be more familiar to the student than a more strictly *astronomical* instrument. It is doubtful, however, whether the theodolite serves as a good introduction to instrumental astronomy or well exemplifies its principles; and the same may be said of the equatorial when used for making absolute (as opposed to differential) measures. The fundamental principles of practical astronomy are not to be found in the development of the formulæ for a general type of instrument; its main problem is the design and use of specialised instruments, in which the mechanical errors are few, and can be as far as possible determined and eliminated. We feel that the treatment of the transit circle has suffered somewhat from the devotion of so much space and the priority accorded to the theodolite and equatorial, though it must be admitted that in his account of it the author has compressed a wonderful amount of matter into a concise form. Besides the three chief instruments, numerous others are briefly described; these include the zenith telescope, coudé equatorial, heliometer, siderostat, and cœlostat.

In most cases this short treatment appears to be sufficient (though we doubt if any reader will be able to picture to himself the coudé equatorial from the description given); but when the whole subject of astrophotography is likewise dismissed in half a page, some protest seems to be required. Surely this branch of astronomy has now attained a development and importance sufficient to secure for it a place in the text-books. It cannot be urged that the subject is unsuitable for inclusion in the university course; the theory of transformation of coordinates and the formulæ involved should surely appeal more to the mathematical student than the study of the small errors of a transit instrument.

Among the other subjects considered may be noticed an excellent chapter on the fundamental constants of astronomy. Although limitations of space preclude a detailed discussion of the methods of avoiding error, a very fair idea is given of the difficulties and uncertainties involved in the determinations. We are glad to see that in a complementary chapter an explanation of Gauss's method of determining an orbit from three observations has been included in the course.

A. S. E.

OUR BOOK SHELF.

Water Hammer in Hydraulic Pipe Lines. By A. H. Gibson. Pp. iv+60. (London: A. Constable and Co., Ltd., 1908.) Price 5s. net.

The phenomenon of water hammer in pipe mains is one familiar to all who have had any practical experience in matters of water supply, either for domestic consumption or for power purposes. Indeed, it is safe to say that it comes within the observation of most people. There can scarcely be a householder who is not aware that the abrupt closing of a tap, or valve, produces a violent and perfectly audible concussion in a water pipe, though perhaps he may not realise that the shock, if repeated with sufficient frequency, is capable, in process of time, of producing rupture, unless the pipe possess a very large margin of strength to resist so considerable an excess over the normal pressure, or unless a relief valve be provided. This latter expedient is most generally adopted in all important installations, where the consequences of a sudden outburst would be serious, if not disastrous.

In the case of a phenomenon of such common occurrence, it is somewhat remarkable that there is

quite a paucity of investigation into its features and effects. Most text-books on hydraulics content themselves with merely a passing reference, and make no attempt to elucidate any of the interesting and practical problems suggested by the subject. This omission Mr. Gibson has sought to make good by the publication of the results of a series of useful experiments which he has carried out in the engineering laboratories of Manchester University.

The experiments were made with the object of determining the actual rise and fall of pressure in a pipe line due to the gradual, or sudden, closing, or opening, of a valve. For this purpose a cast-iron pressure main was used, of $3\frac{3}{4}$ inches diameter, 560 feet in length, conveying water from an elevated tank, 107 feet above the laboratory floor. The results of four series of experiments are graphically represented, and these and other observations are tabulated in comparison with theoretical values obtained from a formula the construction of which is fully explained.

Mr. Gibson takes his subject-matter a step further, and includes a very useful little chapter dealing with the application of the principles established to the theory of turbine regulation. Altogether, this small volume is an exceedingly welcome recruit to the ranks of original experimental research literature in a branch of natural science which itself is of the greatest practical value to mankind.

Valve-gears for Steam Engines. By Prof. Cecil H. Peabody. Second edition, revised. Pp. vi+142. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 10s. 6d. net.

THIS book is intended to give engineering students instruction in the theory and practice of designing valve-gears for steam engines. Prof. Peabody has dealt with the subject in his usual able manner, and his methods are most lucid. The volume is divided into six chapters, with a good appendix. Graphical methods are used throughout, and the plates at the end of the book are remarkably clear.

The Stephenson link motion is dealt with in chapter iii. This gear has been so long in use that finality might be expected in locomotive practice as regards the correct lead of the valve in full gear; yet this is not the case. The late Mr. William Stroudley was a strong advocate of no lead in full gear, and he obtained remarkable results from his locomotives; others, again, follow the reverse practice.

Chapter iv. deals with the very interesting subject of radial valve-gears, of which, of course, the Walschaert is best for locomotive purposes, and is now being largely used in America in preference to the Stephenson gear, Continental practice having long adopted this course.

This is a revised second edition of the book, and the few changes that have been made have been in the right direction. We can truly recommend the work to all draughtsmen and engineers who have to deal with the interesting and intricate questions which arise when designing valve-gear.

The Bull of the Kraal and the Heavenly Maidens, a Tale of Black Children. By Dudley Kidd. Pp. xii+302. (London: A. and C. Black, 1908.) Price 6s.

MR. KIDD in his earlier works, "The Essential Kafir" and "Savage Childhood," exhibited an intimate knowledge of the social life of the Bantu race. The present book is more popular, being intended to describe a series of typical incidents in the life of a little boy. Mahleka, the "Bull of the Kraal," is the son of the Great Wife of the tribal chief, and his heir-apparent. In sketches of this kind, the work of a sympathetic observer of a semi-savage people, there is the risk, on the one hand, of assuming that any foreigner can fathom the deeper recesses of the native mind. On the other, there is the danger of dwelling on their virtues and ignoring the darker side of the native character. Mr. Kidd seems hardly to have avoided both these pitfalls. He sometimes reads into the mind of the Bantu child ideas foreign to it, and his account of the simple life in the kraal neglects the treachery and ruthless ferocity of the Zulu, which it is never safe for the white man to forget.

With these reservations, his story of this little Zulu boy is both amusing and instructive. The careful account of the games of children will be of value for the comparative study of the subject. The folk-tales collected by Mr. Douglas Wood in south-eastern Rhodesia are, on the whole, disappointing, and contain little new incident. More valuable than these are the scraps of folk-lore which the author loses no opportunity of retailing. Particularly interesting are the illustrations of sympathetic magic. Thus, when a child's hair is cut it is buried in damp soil to make it continue growing; rain-medicine is made out of porpoise flesh, and so on.

The value of the book is much increased by the drawings of kraal life by Miss A. M. Goodall, which are artistic and well selected.

Fruit Trees and their Enemies, with a Spraying Calendar. By Spencer U. Pickering, F.R.S., and Fred. V. Theobald. Pp. 113. (London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd.) Price 1s. 6d. net.

THIS little book is written for the guidance of fruit-growers, perhaps the most intelligent and enterprising of all those who live by the cultivation of the soil. Although spraying has only come into use in England during the last few years, it has been taken up with great enthusiasm; unfortunately, however, the practical man has been in many cases without adequate scientific guidance, and has been left to the mercy of the enterprising advertiser.

The various insect and fungoid pests are described, and brief notes on their life-history are given. Their effect on the fruit or tree is then stated, so that the practical man may have no difficulty in recognising with what he has to deal: finally, recipes are given for making up the appropriate wash. The instructions are clear, and the practical man should have no difficulty in following them. Some of the washes will be new to many growers; they have, however, been tested by the authors, and found to work satisfactorily. Regard is also had to the cost of the operation, as is right in dealing with problems into which financial considerations enter to a large extent. We note that the authors direct attention to the failure sometimes following on fumigation with prussic acid; the proper conditions to ensure success still remain to be discovered.

All who are interested in fruit cultivation will find this book useful.

Die Fauna Südwest-Australiens. Ergebnisse der Hamburger südwest-australischen Forschungsreise, 1905. Edited by Prof. Dr. W. Michaelsen and Dr. R. Hartmeyer. Vol. ii., sections 1–4. (Jena: Gustav Fischer, 1907–8.) Price 12 marks.

A FURTHER instalment of reports on the fauna of south-western Australia, from materials collected by the expedition dispatched from the Hamburg Museum in 1905, has been issued, and contains four

memoirs on groups of insects. The first section of this volume is by J. Weise, of Berlin, and describes the Chrysomelidæ and Coccinellidæ, of which the expedition obtained twenty-eight species, of which nine are new. The second section is by Dr. Bernhauer, and describes the Staphylinidæ, and founds eleven new species, one of which is the type of a new sub-genus. The third section, by Georg Ulmer, of Hamburg, describes the Trichoptera and Ephemeridæ, and includes a synopsis of the Trichoptera known on the Australian continent. This report is illustrated by a valuable series of drawings in the text. Five new species are described, and many larval forms. The fourth section, by F. Silvestri, describes the Thysanura, including fifteen species of Lepisma and one of Japygus. Twelve of the species are new, and one of them represents a new genus. The report is illustrated by ten plates.

The volume gives further evidence of the valuable additions to Australian zoology made by Prof. Michaelsen and Dr. Hartmeyer's expedition.

Lehrbuch der Muskel- und Gelenkmechanik. By Prof. H. Strasser. I. Bd. Allgemeiner Teil. Pp. xi+212. (Berlin: Julius Springer, 1908.) Price 7 marks.

THIS book is the work of one who has made animal mechanics a life-study. Prof. Strasser will be particularly remembered on account of his work, published some twenty years ago, upon the flight of birds and the swimming of fish.

The first section of his book—some seventy-three pages—is devoted to an admirable digest of the mechanical principles involved. It is illustrated by plenty of figures.

The second part is devoted to the skeleton, the mechanical prop; the movements at the joints; the different forms of muscle, the angles which the individual fibres make when inserted into bone, and muscle work.

The third section refers to the general problem of the joints and muscles, and deals with several static problems in the first case, and with locomotion in the second.

The author has treated the whole subject much as one would treat an ordinary physical problem, in all mathematical detail. He is to be congratulated upon his method and upon the way in which he has carried it out. We believe that there is no treatise in the English language which can be considered as quite on all fours with his book, and we can heartily recommend its study.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Diurnal and Semi-diurnal Atmospheric Variations.

I HAVE read the remarks of Prof. Horace Lamb in NATURE, November 5, 1908, p. 24, and November 12, 1908, p. 47, where, although mentioning difficulties, he apparently accepts the suggestions of Kelvin, Margules, and Hann that the semi-diurnal wave of pressure can be explained by the fact that "the daily variation of temperature is not harmonic, and when analysed there is a definite component with a half-day period," and "on a rotating earth the period of free oscillation of the atmosphere lies very near to twelve hours."

In connection with this, I wish to direct attention to the fact that an analysis of the records of instruments carried by kites shows that the chief oscillation in temperature in the body of the atmosphere is a semi-diurnal one, and not a single oscillation such as is found near the ground.

In a discussion of the observations obtained with kites at the Blue Hill Meteorological Observatory, published in the annals of the Astronomical Observatory of Harvard College, vol. lviii., part i., 1904, I showed that the single diurnal oscillation of temperature nearly disappears within 300 metres of the earth's surface, and from 500 metres to 1500 metres only a semi-diurnal oscillation is distinctly apparent.

For the method employed the reader must be referred to the publication mentioned. The final results in degrees Fahrenheit were as follows:—

Normal Diurnal Temperatures at different Levels above Blue Hill.

Height in metres	A.M. 1	3	5	7	9	11	P.M. 1	3	5	7	9	11	Mean
	°	°	°	°	°	°	°	°	°	°	°	°	°
15	39·9	37·9	37·7	39·4	47·9	51·8	53·8	53·9	51·5	47·2	42·8	41·2	45·4
500	45·7	46·0	45·6	44·6	43·5	44·1	45·8	45·8	44·2	43·2	43·6	44·6	44·7
1000	40·4	40·4	40·5	40·4	39·8	40·1	40·5	40·4	40·3	40·3	40·0	40·0	40·2
1500	37·5	36·9	36·5	36·8	36·0	34·5	35·2	36·4	36·1	34·7	34·9	36·9	36·0

The harmonic values computed from the observations are as follows, the epoch in each case being midnight:—

Height		Harmonic values
15 m.	...	$45{\cdot}4+8{\cdot}33 \sin(234+x)+1{\cdot}63 \sin(73+2x)+$&c.
500 m.	...	$44{\cdot}7+0{\cdot}47 \sin(13+x)+1{\cdot}67 \sin(18+2x)+$&c.
1000 m.	...	$40{\cdot}2+0{\cdot}09 \sin(85+x)+0{\cdot}35 \sin(344+2x)+$&c.
1500 m.	...	$36{\cdot}0+0{\cdot}90 \sin(47+x)+0{\cdot}80 \sin(0+2x)+$&c.

These results show that the amplitude of the single diurnal period near the earth's surface (15 metres above sea-level) is 8°·3 F., but at 500 metres it has decreased to less than half a degree Fahrenheit, and at 1000 metres to less than a tenth of a degree Fahrenheit. At 1500 metres the range apparently increases somewhat, but this is perhaps owing to the small amount of data available at that height. The mean of all the daily ranges between 500 metres and 1500 metres, inclusive, is slightly less than half a degree. Furthermore, at 500 metres to 1500 metres the phase angle has changed nearly 180° as compared to that at the earth's surface, so that the maximum in the daily wave of temperature comes at night instead of during the day. The reversal of phase apparently takes place between 300 metres and 500 metres.

Turning to the values in the formula showing the semi-diurnal period, it is seen that at 500 metres and 1000 metres the amplitude is nearly four times as great as is the amplitude of the diurnal period, but at 1500 metres the two appear to be nearly equal. The maxima in temperature are about 3 a.m. and 3 p.m., not far in time from the semi-diurnal minima of pressure, while the minima of temperature are near 9 a.m. and 9 p.m., not far from the times of the semi-diurnal maxima of pressure.

In commenting on these results in the publication referred to, I say (p. 32):—"But the fact of particular interest is that the mean of the amplitudes of the semi-diurnal period from 500 to 1500 metres, thus including the larger portion of the lower atmosphere, is greater than the mean amplitude of the diurnal period. This fact is of interest in connection with the views of Lord Kelvin, Dr. Margules, and Dr. Hann concerning the cause of the semi-diurnal wave."

In 1905 Prof. Frank H. Bigelow, analysing the data obtained at Blue Hill more in detail and by a method somewhat different from my own, confirmed the existence of the semi-diurnal period of temperature in the body of the atmosphere. He says:—"The single diurnal period at the surface is replaced by a double diurnal wave at 400 metres, and this appears quite plainly in every month except July, where it is probably nearly extinct" (*Monthly Weather Review*, 1905, p. 55).

The existence of a maximum of temperature by day and a secondary maximum at night, with a diurnal amplitude of about 1°·3 C. at a height of 1200 metres above Hald, Denmark, has also been disclosed by W. Wundt in an analysis of the observations made with kites at that station (*Meteorologische Zeitschrift*, 1908, pp. 337–41).

Herr Wundt gives results for the year and for the autumn, the semi-diurnal period being most marked in the autumn, for which I find the following harmonic values:—

Height	Harmonic values
1200 m. ...	$A + 0{\cdot}37 \sin(228 + x) + 0{\cdot}13 \sin(229 + 2x) + \&c.$

In this case the amplitudes are in degrees centigrade, and must be multiplied by 1·8 for comparison with the results at Blue Hill. The amplitude of the single diurnal oscillation is nearly the same as the mean between 1000 metres and 1500 metres at Blue Hill, but the phase angle is nearly 180° different. The amplitude of the double diurnal period is a little less than half that found for Blue Hill. However, the method of obtaining the original data was not the same in the two cases.

HENRY HELM CLAYTON.

Readville, Mass., January 8.

A Method of Solving Algebraic Equations.

PROF. RONALD ROSS gave in NATURE of October 29, 1908, an article upon "A Method of solving Algebraic Equations." Without going into the matter itself, or into details concerning it, I beg to state that the above-mentioned process was published in Germany in 1894 in the two following articles by Dr. W. Heymann, professor an der Kgl. Gewerbe-Academie zu Chemnitz in Sachsen:—

(1) Ueber die Auflösung der Gleichungen vom fünften Grade (*Zeitschrift für Mathematik und Physik*, xxxix., Jahrgang 1894).

(2) Theorie der An- und Umläufe und Auflösung der Gleichungen vom vierten, fünften und sechsten Grade mittels goniometrischer und hyperbolischer Funktionen (*Journal für die reine und angewandte Mathematik*, cxiii. Band, 1894).

Further publications relating to the same subject, and also by Prof. Heymann, are as follows:—

(3) Ueber die elementare Auflösung transcendenter Gleichungen. Mit Beiträgen zur Ingenieur-Mathematik (*Zeitschrift für mathematischen und naturwissenschaftlichen Unterricht*, xxix., Jahrgang 1898).

(4) Ueber Wurzelgruppen, welche durch Umläufe ausgeschnitten werden (*Zeitschrift für Mathematik und Physik*, xlvi. Band, 1901).

I would especially mention, as an article which deals at some length with the geometric explanation of the iteration-process:—

(5) Ueber die Auflösung von Gleichungen durch Iteration auf geometrischer Grundlage (*Jahresbericht*, 1904, *der Techn. Staatslehranstalten zu Chemnitz*).

The author has in this last work thoroughly explained the staircase procession and alternating spiral procession theories, and has also developed the technology of the process, which he further illustrates by a great number of practical examples. I would here direct attention to the fact that this method can be used with advantage in solving transcendant equations. Dr. Heymann has also especially considered in this work those spirals which do not immediately stagnate, but which do so after repeated revolutions; he divides them, therefore, into spirals of the first, second, third . . . *m*th kind.

GEORG SATTLER.

I AM much obliged to Herr Sattler for the information which he has been kind enough to give in regard to my article in NATURE of October 29, 1908, and also for sending me the paper by Prof. Heymann (No. 5) to which he refers. When I wrote my article I could obtain no information concerning previous literature on the method, but since then Mr. W. Stott, secretary of the Liverpool Mathematical Society, has assisted me very greatly with his knowledge of the history of mathematics and with the books in his possession. We are now engaged in making a thorough study of the history of the method, but the following brief account of our progress up to the present may not be out of place.

The method appears to have been discovered by Michael Dary, a gunner in the Tower of London, on August 15, 1674, and was communicated by him in a letter of that date to Isaac Newton (see the "Macclesfield Letters," Correspondence of Scientific Men of the Seventeenth Century, University Press, Oxford, 1841, vol. ii., p. 365). In this letter he indicates clearly that a root of a trinomial equation can be obtained by putting the equation in the form $z^p = az^q + n$, and then by approximating to the value by "iteration"—just as described in my paper. Subsequently he wrote a book called "Interest Epitomised, both Compound and Simple, whereunto is added a Short Appendix for the Solution of Adfected Equations in Numbers by Approachment performed by Logarithms" (London, 1677), but we have not yet been able to procure a copy of this work. Dary was a *protégé* both of Isaac Newton and of Collins. The former subscribed himself in a letter to Dary "your loving friend"; and the latter (to judge by the same "Letters," vol. i., p. 204) tried to advance him, and wrote of him:— "'Tis well known to very many that Mr. Dary hath furnished others with knowledge therein (arithmetic), who, publishing the same, have concealed his name; as, for instance, Dr. John Newton hath lately published a book of Arithmetic, another of Gauging; all that is novel in both he had from Mr. Dary."

I do not know the date when the great Newton first described his method of approximation, but fancy that it must have been done in his "Universal Arithmetic," written about 1669 (the method has been also ascribed to Briggs). The matter is of some interest, because Newton's method is a variant of Dary's—or rather both are special cases of a more general method. In approximating to the intersection of two curves by iteration we may employ either an orthogonal or an oblique geometric construction. The former is the method of Dary (as illustrated in my paper), the latter is the method of Newton, the angle of the oblique construction varying at each step and being taken as that of the tangent of one of the curves at the starting point of the step. Obviously the oblique process gives the quicker approach, and Newton's

$$(x_2 = x_1 - fx_1/f'x_1)$$

gives the quickest possible if we start sufficiently near the root. Newton was probably aware of this, and consequently did not elaborate Dary's method. Nevertheless, Dary's method is, with certain modifications, the more certain; and, at any step, we can pass from the one process to the other.

The subject now becomes divided into two, the functional theorem, that an iterated function may converge toward the root of an equation, and the converse theorem, that the root of an equation may be calculated by the iteration of a function. The next work which I have seen on the latter theorem is contained in the appendix to the third edition (1830) of Legendre's "Theorie des Nombres" (copies of the second edition may not possess the appendix). He calls this "Méthodes nouvelles pour la Résolution approachée des Équations numeriques," but begins with Newton's method (without acknowledgment) and continues with Dary's. Legendre's paper is curious. He gives the geometric representation of both methods, but omits entirely the "spiral process" mentioned in my paper. We cannot suppose that such a master was ignorant of that process, but must rather believe that he put it aside because he thought it inconvenient for practical calculation (which is not the case if suitable precautions are taken). In order to confine himself to the "staircase process" he puts the proposed equation in the form of "fonctions omales" (homalous), but with the result only that he must often obtain a very slow convergency. In order to extract the successive roots he makes no better suggestion than to divide out the first root already obtained, and the idea of starting the process alternately on the two curves in order to obtain one root after another seems not to have occurred to him. His paper is ingenious, but insufficiently generalised. Prof. Heymann has criticised it to the same effect.

Heymann mentions a number of contributors on the functional side of the theorem, Jakob Bernoulli, Gauss, Jakobi, Stern, Schlömilch, Schröder, Günther, von Schaewen, Hoffmann, Netto, and Isenkrahe. Possibly Babbage, Boole, Galois, and De Morgan may have done as much at an earlier date than some of these writers. De Morgan, in his article on the calculus of functions ("Encyclopedia Metropolitana," London, 1845, vol. ii.,

p. 310), gives a brief but complete summary, except that he does not mention the possibility of obtaining successive roots by starting alternately on the two curves. He also demonstrates the geometric representation, shows that $\phi^n(x)$ may approach "in regular succession to different limits," and notes the connection of iteration with many parts of algebra and the calculus.

More recently, Lémeray has a series of papers on the functional side of the theorem. In one of the earliest of these ("l'Intermédiaire des Mathematiciens," June, 1894) he considers in detail the conditions of convergence of $\phi^n(x)$, but thinks that the method is not generally applicable for the solution of equations (which is incorrect). In this and succeeding papers he gives ample geometric illustrations, including both the "staircase" and the "spiral" procession, but exhibits few examples. He deals at length with the "stagnating spiral" procession.

It will thus be seen that the first paper of Prof. Heymann mentioned by Herr Sattler has about the same date as the first paper by Lémeray. Many other papers have followed. According to Heymann, Isenkrahe described (1897) both the "staircase" and "spiral" process under those names (which have been used by me). Mr. Stott has found other references (which we have not yet been able to verify), especially Anostschenko (1901), Pellet (1901), and Bugaieff, who appears to have published a series of papers since 1896, covering the whole subject of successive approximation (in Russian).

The work by Prof. Heymann which Herr Sattler sends me (No. 5) is dated 1904. It commences by describing the process, with both forms of approach; discusses the determination of imaginary roots, hastening of convergency, Newton's method, expedients for calculation, and some of the literature of the subject; considers the "stagnating" spiral, and gives examples and figures, being thus the most thorough paper which I have seen on the equation side of the theorem.

It would seem, then, that the method has been known to many writers since the time of Dary and Newton, but none of them appears to have carried it much further than the more obvious deductions to be drawn from the original theorem, as shown in my note. I think, however, that some further developments, both on the theoretical and the practical side, remain to be considered, but it would be scarcely useful to mention them until we have been able to examine all the literature.

We shall be very glad to receive any further references on the subject. If an amateur may say so, it is extraordinary that so beautiful and general a method should have received so little attention in the text-books.

Ronald Ross.

University of Liverpool, January 11.

A February Meteoric Shower.

February cannot offer the same attraction as January and April in regard to the occurrence of a meteoric shower of special importance; but large meteors are fairly abundant during the month, and though no exceptionally rich streams are in evidence, there are a number of minor systems in play, and these will well repay attentive observation.

For a great many years I have suspected a strong shower in this month, but have never thoroughly investigated it. Meteors have been prolific from the direction of the bright star α Aurigæ (Capella), and the dates over which the display extends appear to be from the 5th to the 20th. This year the moon will not much interfere with observation between February 10 and 25, and the sky should be carefully watched on clear nights for these Aurigids. They are brilliant, slow-moving meteors, and occasionally take rank as fireballs.

It will be important to determine the date of maximum and the exact place of the radiant. I found the position at $75^\circ + 41^\circ$ from various meteors seen from Bristol in the month of February in various years, but I have never watched the shower with sufficient thoroughness to learn much of its aspect or discover the epoch of its richest presentation; but I think it is decidedly a stream of rather notable character, and one which obviously needs further attention.

W. F. Denning.

Women and the Fellowship of the Chemical Society.

It has come to our notice that a report has been widely circulated and credited to the effect that the movement in favour of the admission of women to the fellowship of the Chemical Society is directly connected with the present strenuous agitation for the political enfranchisement of women. We, the undersigned women (actively engaged in chemical teaching and research), beg to ask for the hospitality of your columns in order emphatically to deny any such connection. The following facts, we venture to think, should conclusively prove the independence of the two movements:—

(1) Five years ago, when some of us petitioned the council of the Chemical Society to admit us to the fellowship, the agitation in favour of "Woman Suffrage" was not prominently before the public.

(2) The petition recently presented to the council originated within the Chemical Society itself, and was signed exclusively by fellows of the society. Moreover, we as a body have no knowledge of the political opinions and aspirations held by individual members; any such knowledge we should consider to be quite irrelevant, since the only link which unites us is a common interest in the science of chemistry.

We are glad to take this opportunity of recording our thanks to those fellows of the Chemical Society who have expressed themselves in favour of admitting women to the fellowship of the society.

Signed: Mary Boyle, B.Sc., Lecturer and Demonstrator in Chemistry, Royal Holloway College; K. A. Burke, B.Sc., Assistant in Department of Chemistry, University College, London; Louisa Cleaverley; Margaret D. Dougal, Indexer of the Publications of the Chemical Society; C. de B. Evans, D.Sc., Lecturer in Chemistry, London School of Medicine for Women; E. Eleanor Field, M.A., Senior Staff Lecturer in Chemistry, Royal Holloway College; Emily L. B. Forster, Private Assistant to Prof. Huntington, King's College, London; Ida Freund, Natural Science Tripos, Cambridge, Staff Lecturer in Chemistry, Newnham College; Maud Gazdar; Hilda J. Hartle, B.Sc., Lecturer in Chemistry, Homerton Training College, Cambridge; E. M. Hickmans, M.Sc.; Annie Homer, B.A., Fellow and Associate of Newnham College, Cambridge; Ida F. Homfray, B.Sc.; E. S. Hooper, B.Sc., F.I.C., Assistant Lecturer and Demonstrator, Portsmouth Municipal College; Edith Humphrey, B.Sc., Ph.D., Chemist to A. Sanderson and Sons; Zelda Kahan, B.Sc.; Norah E. Laycock, B.Sc., Demonstrator in Chemistry, London School of Medicine for Women; Effie G. Marsden; Margaret McKillop, M.A., Lecturer in Chemistry, King's College, Women's Department; Agnes M. Moodie, M.A., B.Sc.; Nora Renouf, Salters' Research Fellow, School of Pharmacy; Ida Smedley, D.Sc., Assistant Lecturer and Demonstrator in Chemistry, Victoria University, Manchester; Alice E. Smith, B.Sc., Assistant Lecturer and Senior Demonstrator in Chemistry, University College of North Wales, Bangor; Millicent Taylor, B.Sc., Lecturer in Chemistry, Ladies' College, Cheltenham; M. Beatrice Thomas, M.A., Lecturer in Chemistry, Girton College, Cambridge; M. A. Whiteley, D.Sc., A.R.C.S., Demonstrator in Organic Chemistry, Royal College of Science, London; Sibyl T. Widdows, B.Sc., Head of Practical Chemistry Department, London School of Medicine for Women; Katharine I. Williams.

Fog and Rime on January 27–28.

The great fog which enveloped the neighbourhood of London as well as a large part of England on January 27 and 28 was remarkable in rural and outer-suburban districts for the beautiful decking of the trees, even the tallest elms, with a great thickness of rime.

Here at Northwood, sixteen miles to the north of London, twigs and branches were heavily laden on their windward side—or rather that which faced the direction of the feeble anti-cyclonic air-flow. At night time, when

the fog was very dense, one's hair and overcoat also received a thick deposit of hoar-frost. It is noteworthy that in central London the fog, being exceedingly carbonaceous, and pungent with SO_2, was too dry to deposit much ice or rime on the trees in Hyde Park, although the grass was thickly coated through terrestrial radiation. I have never seen much hoar-frost on the bare forest trees *without fog*, and I think that other observers will agree that the presence of fog is necessary for any great thickness to be formed. The dryness of the smoky town-fog as compared with the country-fog is well known, and this whether the temperature of the air is below the freezing point, as in the case in question, or above it. On the above dates at Northwood the fog dispersed for a couple of hours at mid-day, and the sun shone upon a fairyland in a sky of cloudless blue.

L. C. W. BONACINA.

Northwood, Middlesex, February 1.

Germination of the Broad Bean Seed.

THE text-book statements on the relation of the micropyle to the radicle are entirely wrong so far as I have been able to observe. If the testa be carefully removed it will be found to have two compartments, the larger one covering the cotyledons and the smaller sheathing the radicle. A fine bristle passed through the micropyle enters the cotyledon compartment. When the radicle emerges it does not pass through the micropyle, which is left intact, but the testa splits along two lines of weakness running from the tip of the radicle to its junction with the cotyledon stalks.

I noticed this about six years ago, and though I attach no importance to the mere fact, its interest is considerable from the point of view of nature-study in schools.

E. HEBER SMITH.

Episcopal Training College for Teachers, Dalry House, Orwell Place, Edinburgh, January 19.

"Vestiges of the Natural History of Creation."

IN "Vestiges of Creation," ninth edition, 1851, p. 113, it is stated that two independent investigators caused the production of "living insects" (*Acarus crossii*) by the prolonged action of a voltaic battery upon certain chemical solutions. The description is most matter-of-fact. The second experimenter seems to have sterilised his apparatus and solutions before use; yet it is said that the insects "were sometimes observed to go back to the fluid to feed, and occasionally they devoured each other." In Note 54 it is also stated that "after they have escaped from the solution they live in the neighbourhood, and readily breed."

I shall be much obliged if any reader can explain the above phenomenon, or say if the experiments have been repeated.

F. WYVILLE THOMSON.

Caledonian United Service Club, Edinburgh, January 28.

THE RADIUM INSTITUTE.

THE announcement that, on the initiative of the King, a Radium Institute will shortly be opened in London is of the greatest interest to the man of science and to the physician. The institute is intended not only for research work, but also for curative purposes, and it will have an organised medical department. The whole of the funds necessary to build, equip, and maintain a new establishment are being provided by Sir Ernest Cassel and Lord Iveagh. We are reminded that Lord Iveagh gave the munificent sum of 250,000*l*. to endow the Lister Institute of Preventive Medicine, so that his name will now be associated gratefully with two great endowments of science. The committee of the institute will consist of Sir Frederick Treves, Bart., G.C.V.O., C.B. (chairman), Sir William Ramsay, K.C.B., F.R.S., Sir J. J. Thomson, F.R.S., the Hon. R. J. Strutt, F.R.S., Sir Lauder Brunton, Bart., F.R.S., Sir Malcolm Morris, K.C.V.O., and two other members, one each to be nominated by Sir Ernest Cassel and Lord Iveagh.

The interest which the King is exhibiting in the inauguration of a scientific institution for further research work with radium, so that its powers may be utilised for the amelioration of human suffering, has led to the publication in the Press of the useful purposes to which radium may be put, and the inauguration of the Radium Institute will provide another example of the supreme importance to mankind of research work in science. The difficulty hitherto has been that so little of this remarkable body has been available for research. The trouble has been a financial one. Not long ago good specimens of radium bromide were obtainable for 5*l*. per milligramme, but recently the price has reached 16*l*. to 18*l*. per milligramme. It is obvious that in any case an enormous expenditure is required before a sufficiency can be obtained adequate for an institute, for the investigation of the properties of radium and its application for the treatment of disease. The necessary funds having now been provided, it will be possible to study radium from many points of view.

Radium is the most interesting of a group of bodies characterised by the property of spontaneously emitting radiations capable of passing through plates of metal or other substances impermeable to light. In 1896, Becquerel found that uranium compounds and the metal itself give off rays which cause changes in a photographic plate even when passed through thin plates of metal. Uranium was isolated from pitchblende so long ago as 1789 by Klapworth, and a little more than a hundred years later, in 1898, M. and Mme. Curie discovered that certain varieties of this mineral possess greater radioactivity than could be accounted for by the uranium they contained. They were led to investigate these forms of pitchblende, and succeeded in isolating two new elements, polonium and radium.

The discovery of radium and its investigation have opened up enormous fields of research, and the following brief account of what has been done will suggest the possibilities before the Radium Institute, especially if a considerable quantity of the element can be under investigation.

Radium gives off three kinds of rays, respectively called α, β, γ rays, which have various properties. The α rays are identical with the radiations of high velocity, carrying a positive charge of electricity, which are projected through a perforation in the kathode of a Crookes's tube. They have been called "canal rays" by Goldstein, and have been investigated particularly by Wien. They travel in the opposite direction to the current through the tube, and have the power of ionising gases. The β rays consist of negative particles, identical with the rays which are given off from the kathode and called "kathode rays." They have a velocity equal to that of light, and can be deviated by a magnetic field. The γ rays are similar to the X-rays. They are not deflected by a magnetic field.

These rays have different powers of penetration. This is estimated by interposing layers of aluminium. The α rays have the least penetrative power; according to Rutherford, they may be taken as unity, the β rays as of a penetrative power of 100, and the γ rays as of a penetrative power of 10,000. Practically the rays may be filtered by interposing layers of aluminium and lead. For instance, both the α and β rays are completely absorbed by a layer of lead only one centimetre thick, but the γ rays will pass through a layer of lead an inch thick. They are more penetrating than the X-rays.

The α and β radiations have the power of developing phosphorescence in certain bodies, notably zinc sulphide, the platinocyanides, and the diamond. All strongly radioactive substances emit light themselves and are phosphorescent in the dark room.

Alterations in colour occur in glass and certain precious stones; for instance, the diamond and the ruby, when exposed to radium. These phenomena are seen also in an X-ray tube, and are believed to be due to the β or kathode rays.

Chemical changes produced by radium are of great interest, and here, we believe, there will be found on further investigation a remarkable field for work. Oxygen is changed into ozone. Water is converted into peroxide of hydrogen. The radium emanation has also the power of re-combining hydrogen and oxygen to form water. It is believed that the α rays are the agents of these changes. The β rays convert yellow phosphorus into the red variety, and liberate iodine from some of its compounds.

The chloride, bromide, sulphate and carbonate of radium are known, but the metal itself has not yet been isolated. The element is believed to be dibasic, and resembles barium in its compounds. The atomic weight is about 226·7 (Thorpe). In 1900, Dorn discovered that radium constantly gives off an emanation. This emanation is a gas, and it can be pumped off. The emanation produces heat. One grain of radium is believed to emit about 80 gram-calorics in an hour (Precht). As radium is constantly giving off emanation it is undergoing decay, and there is reason to believe that this decay is exceedingly slow. A number of investigations have been made to determine its "life." The "life" of the emanation is less than four days. That of radium probably as long as 1750 years.

The spectrum of radium emanation has been investigated by several workers, and Ramsay and Soddy have observed its change into helium, but it is not yet certain whether other bodies are not produced.

One great problem which lies before the physicist in his work with radium and kindred bodies is the possible transformation of elements. It is believed that the gradual change of radium is in the direction of lead. The production of helium was detected by spectroscopic examination, and so far the work has chiefly rested on this form of observation, but there appear to be chemical evidences also. Several fascinating theories have been put forward to explain the evolution and devolution of elements, but at the present time all that can be done is the accumulation of facts.

Turning now to the medical aspects of radium, and naturally these appeal most to the general public, it may be stated that its field in therapeutics has been studied for some years, and its limitations are fairly evident. Radium kept in contact with the skin, or separated from it by clothing, has produced intractable burns, similar to those induced by excessive exposure to the X-rays. Cases of nævus, port-wine stains, and moles, both of the pigmented and hairy varieties, have been removed by it. Warts also rapidly disappear. So far the effects have been seen in superficial conditions. Rodent ulcer, a superficial form of skin cancer, has been cured by radium, just as it has by the X-rays, but there have been cases in which, by its greater penetrative power, no doubt, radium has succeeded where the X-rays have failed. The cure of rodent ulcer by radium has been proved to be lasting by a case shown recently at the Royal Society of Medicine, the cure having lasted for five years. What everyone wants to know is whether in radium we have the long-sought cancer cure. It is by no means likely, but it is not impossible. It is true that mouse-cancer can be removed by it, but cancer induced in mice is a very different thing from human cancer. Sir Frederick Treves points out that the power of radium to effect its cures is immensely increased by using a quantity. The Radium Institute, it is hoped, will be in possession of such a quantity that it will be able to give an answer to this all-important question of cancer cure. Above all things, it is important that the public should know that so far clinical work has been negative in cancer proper.

It might have been supposed from the articles which have appeared in the daily Press that very little work had been done in this country with radium as a curative agent, but that is not the case, considering the small quantity of the salts which have been available. Radium is best applied on a flat surface, and the difficulty has been to spread the substance evenly and coat it with a varnish that can be sterilised by heat or otherwise. The importance of this will be realised when the radium has to be placed in contact, or at any rate very close, to diseased surfaces. This difficulty has been overcome by Ganne.

All the early work with radium has been done with material obtained from pitchblende derived from Joachimsthal, in Bohemia. According to Strutt it is present in small quantities in several places, and that most likely to be now worked is in Cornwall, where there is pitchblende containing 48·5 millionths per cent. of radium, and also a cupro-uranite, which has no less than 120 millionths per cent.

THROUGH THE HEART OF LABRADOR.

IN 1903 Leonidas Hubbard, jun., a young American journalist, conceived the idea of exploring Central Labrador and passing through the country by means of the water-way from Hamilton inlet to the shores of the Arctic Ocean at Ungava. Only one white man, the gallant Père Lacasse, has accomplished this journey if we except the wonderful pilgrimage of John McLean, who travelled up to the Arctic through Labrador and back to the St. Lawrence by a slightly different route. We know how poor Hubbard missed his way and travelled by a somewhat circuitous route to within sight of Lake Michikamats, and then, after being forced to retreat before the oncoming winter, perished miserably from starvation on the banks of the Susan River within a short distance of food and help. The hero of that journey and subsequent events was George Elson, who, with a Cree Indian, a Russian half-breed, and a young Eskimo, accompanied Mr. Hubbard's wife in the attempt to carry out the journey and the mapping of certain geographical features which the unfortunate explorer had failed to do. That the effort was successful is evinced in the interesting volume, "A Woman's Way through Unknown Labrador."[1]

With such skilled helpers it is plain that Mrs. Hubbard was a mere passenger on the trip, for she had to undergo no hardships worse than the bites of insects; but that she is a woman of no small courage is seen in a hundred ways, for it takes nerve of the 3-o'clock-in-the-morning variety, as the writer can testify, to shoot boiling rapids in a light 19-feet canoe, and the pluck she showed in pushing on, after reaching the height of the land at Lake Michikamats, where doubts as to the chance of reaching Ungava or even Davis inlet before the autumn freeze-up were freely expressed, was of no mean order. Then, too, the chance of missing the one annual steamer, with

[1] "A Woman's Way through Unknown Labrador. An Account of the Exploration of the Nascaupee and George Rivers." By Mrs. L. Hubbard, Jun. Pp. xvi+338. (London: John Murray, 1908.) Price 10s. 6d. net.

the prospect of a year of monotony and cold, did not deter this courageous lady, nurtured in the lap of cities.

The record of the journey as far as Lake Michikamats is somewhat tedious and not of much interest to experienced travellers. Too much is made of trivial incidents, and the humour of the writer is not of a high order. Only once is she allowed to wander a little way from camp, and the result is one of the poorest jokes on record. Chapter viii. is entitled "Scaring the Guides," and twelve pages are devoted to the *fun* of throwing her four excellent helpers into a state of fear, to say nothing of the loss of many cartridges, of which, by her own account, they had only a small stock, just to see how great a commotion would be made by her supposed loss. This might be amusing in the Thames Valley or on the St. Lawrence River, but it does not seem quite the right thing in Central Labrador.


The Nascaupee Chief and Men. From "Through Unknown Labrador."

Mrs. Hubbard's account of her first meeting with the trekking herds of Barrenland caribou is full of interest, and she was indeed fortunate to have witnessed a sight that some white hunters would give much to see. The author expresses the view that the deer are being decimated, and that in a few years only a remnant of the vast numbers will be left. With this view we do not agree. They may be killed off locally, and even desert some area for a number of years, a circumstance which gives rise to such statements; but the main body, in spite of ruthless slaughter at certain points and seasons, will live on. Every year at least 8000 to 10,000 caribou are killed in Newfoundland out of a rough total of 200,000, and yet those deer are on the increase, and every year numbers of tales are published that the deer are being exterminated. These come from districts which the erratic caribou have left temporarily, and to which they may return.

There is a delightfully feminine touch in Mrs. Hubbard's description of her first meeting with the deer and their alarming appearance:

"When they saw us, the stags lined themselves up in the front rank and stood facing us with heads high in a defiant air. It was a magnificent sight. They were in summer garb of pretty brown, shading to light grey and white on the under-parts. The horns were in velvet, and those of the stags seemed as if they must surely weigh down the heads on which they rested. . . .

"I started towards the herd, kodak in hand, accompanied by George, while the others remained at the shore. The splendid creatures seemed to grow taller as we approached, and when we were within 250 yards of them their defiance took definite form and, with determined steps, they came towards us.

"The sight of that advancing army under such leadership was decidedly impressive, recalling vivid mental pictures made by tales of the stampeding wild cattle in the West. It made me feel like getting back to the canoe, and that is what we did. We and the caribou stood watching each other for some time. Then the caribou began to run from either extremes of the herd, some round the south end of the hill, others away to the north, the battle line of stags still maintaining their position.

"After watching them for some time, we again entered the canoes. A short paddle carried us around the point beyond which the lake bent to the north-west. There we saw them swimming across the lake. Three-quarters of a mile out was an island, a barren ridge standing out of the water, and as they swam they formed a broad, unbroken bridge, from mainland to island, from the farther end of which they poured in steady stream over the hill top. . . . The country was literally alive with the beautiful creatures."

The account, brief as it is, of the meeting with the Montaignais and Nascaupees is full of interest, and Mrs. Hubbard used her eyes and ears to some purpose in her short study of these wild people. It is a pity that there are not more ethnological notes of this kind in the book, for what we want to know of Labrador is not the common incidents of travel, experiences such as every schoolboy puts in his first book, but first-hand observations of its botany, mineralogy, zoology, and ways of the wild races. But if Mrs. Hubbard does not give us a very satisfactory or scientific study of Labrador, she leaves us with the impression of a charming and plucky little

woman, whose devotion to her husband and his dreams is pure and true. All men approve of that kind of woman, and wish her and her book every success. Mention must be made of an excellent introduction by Mr. William Cabot, which summarises the work of previous travellers in Labrador; also of a good map by Mrs. Hubbard at the end of the volume, which will be of great service to future travellers.

J. G. MILLAIS.

A TROPIC ISLE.[1]

"IF a man does not keep pace with his companions, perhaps it is because he hears a different drummer. Let him step to the music which he hears." Our beachcomber is a squatter in search of the "simple life." He takes up a little island off the coast of Queensland, determined to make it his home and himself master of all the lore that is thereon. Dunk Island, as it is called, is situated about lat. 18° S., and, being really a part of Australia, with high hills and fringing reefs of coral, presents a picture which may well serve in miniature for any tropic isle of continental origin. The rainfall is abundant, and the jungle is a well-described medley of trees, ferns, and lianes, chief of them the climbing palm.

A little of the ground is cleared, the homestead is erected, the praises of the papaw and banana are sung. The beachcomber has enough and contends no more. Birds delight him and guns are taboo. However, civilisation will out, and a census is taken, social as well as numerical. The sagacious megapode hatches its enormous egg (12 per cent. of its own weight) in its own dung heaps. The swamp pheasant plays "hawk" to the fowls. The bee-eater and wood swallow make bee-keeping impossible. The eagle is a detective, deadly foe to snakes of land and sea. The nutmeg pigeon brings news twice a year from the outside world, and other pigeons perennially express their doleful remonstrances at the poor crops of figs on the banyan trees. Lastly, the sea birds have returned, and the owner has been driven off his own paths, annexed for their breeding fairs. There is, too, the Echidna, dainty morsel for the aged blacks, and the story of the snake and the nest eggs is charming. Of insects we desire to hear more.

In one bay is a garden of coral, killed off by brown mud after a storm, but sprouting afresh from out the slimy mass. It is pictured as a July garden—the island is situated within the Great Barrier Reef—but yet the most cruel battlefield of nature. Corals grow over and smother all they can. Molluscs are murderers and cannibals. "No creature at all conspicuous is safe, unless it is agile and alert, or of horrific aspect, or endowed with giant's strength, or is encased in armour." The clam sits on the coral, and becomes embedded as it grows up around. Serpula is more successful, raising its anemone-like head well above the surface of the coral in a tube of lime. Fish are like gigantic butterflies hovering over flowers. Bivalves tunnel the coral, and sea-urchins grind to powder its limestone ramparts, gnawing off the crumbs of coral which fill up the greater part of their digestive organs. The *bêche-de-mer* is there too, and oysters of many kinds. Then there is the dugong in herds, frolicking in the water, human in its affection for its young. It is a seaweed feeder; it does no harm—but it makes good bacon. Is the love for all nature, so markedly professed, consistent with its destruction? The descrip-

FIG 1.—A Protected Coral Garden. From "The Confessions of a Beachcomber."

[1] "The Confessions of a Beachcomber." By E. J. Banfield. Pp. xii+336. (London: T. Fisher Unwin, 1908.) Price 15s. net.

tion of its chase was surely written by one who loved "the sport."

We would freely acknowledge the literary charm, the wealth of metaphor, the artistic qualifications, and the excellent powers of observation of our beachcomber. At the same time we direct attention to some faults in his work, because we hope to see it pass into a second edition and become a classic for naturalists. In the first place a hundred pages are dragged in quite irrelevantly at the end on the characteristics of black boys, while the last gin on Dunk Island died in 1900. The chapters are unpleasantly broken up into sections, often absolutely disconnected. The studies of the interrelations of climate, of soil, of plant life, and of animal life are what make the works of our great naturalists of enduring value. Our author is peculiarly vivid and discriminating where he allows himself to draw such pictures, and we would have more of them. He has half-a-dozen islets at hand, and the varied coast of Queensland. Scientific terms and names should be carefully checked to ensure correctness. Lastly, an index is essential.

J. S. G.

FIG. 2.—Alcyonaria (leathery Corals) and Oysters. From "The Confessions of a Beachcomber."

CHEMISTRY IN JAPAN.[1]

ALTHOUGH a very few Japanese, through reading works in Dutch, had been experimenting in chemistry some fifty years ago, it was not until about a third of a century back that the science began to be taught in Japan by experiment and by courses of lectures, and that soon after young men of that nation, already trained in chemistry, were to be seen, though rarely, in British and other European laboratories.

[1] Collection of Papers contributed on the occasion of the celebration of Prof. J Sakurai's jubilee. Reprinted from the Journal of the College of Science, vol. xxv. (Tokyo, August, 1908.)

The circumstance most affecting the labour of a Japanese in studying chemistry and other sciences, at least in the earlier days, has been the necessity to acquire ideas through one or more foreign tongues—English, German, French, Dutch—as far removed in grammar from his own tongue as could well be. This fact does, indeed, add seriously to his labour in his younger days, but it is ultimately quite other than detrimental to his progress. For this labour is largely due to the necessity from the first of getting a clear notion of the meaning of terms, which, when obtained, should be a precious possession to everyone. So, too, it may be said of the apparent burden on the youthful Japanese of having to acquire facility in writing, and that, too, with a soft brush, the vast and elaborate script of his own language. For, whilst it is true that to do so takes years of school life, it is certain and quite obvious that the task gives such delicacy of touch and such deftness in the use of the hands as proves invaluable afterwards in the arts and in the laboratory.

Somewhat more than a year ago, the half-jubilee or twenty-five years' professorship of chemistry in Tokyo of Dr. Joji Sakurai was celebrated by his colleagues, pupils, and other friends. To enlarge upon Prof. Sakurai's career as a chemist not being the object of this communication, it suffices to say of him that he is no stranger in this country, that he is the author of well-known researches, that his influence as a teacher in Japan has been great, and that he is now the director of the Imperial College of Science in Tokyo, as well as one of the professors of chemistry.

The particular purpose of this article is to direct the attention of those interested in scientific development to an incident in connection with the jubilee which, though common enough in similar cases in Germany, seems quite remarkable in a country so

young in science as Japan. This was the proffer by Sakurai's chemical colleagues of a number of original papers, some ready and others nearing completion, to be published together as a festal number of the Journal of the College of Science in honour of the event. Together they form nearly half of vol. xxv. of the journal, the rest of the volume, it is of interest to state, consisting of a botanical paper in Latin by B. Hayata, entitled "Flora Montana Formosæ," and illustrated by forty-one exquisite plates. Prefixed to the copies of the chemical part of the volume which have been issued separately for presentation purposes is a biographical sketch of Sakurai, by Prof. N. Matsui, director of the College of Agriculture.

The contents of this publication are ample evidence of the striking and wonderful success, in the course of relatively few years, of Japan's venture into the field of chemical research. There are seventeen papers, touching nearly all parts of present chemical investigation, all of them of value as original contributions, some of very considerable value, and most of them fixing the attention. In abstract they are now appearing, or have already appeared, in European journals; any one of them would have been accepted for publication here or in Germany (two are in German). One was partly published at the time of the jubilee in the *B. d. deutschen chem. Gesellschaft.*

"The Viscosity of Dilute Alcoholic Solutions," by T. Hirata; "Die Anomalie der starkeneinwertigen Electrolyte," by M. Katayama; and "Coagulation of Colloidal Aluminium Hydroxide by Electrolytes," by S. Kawamura, are three examples of excellent work. Two other papers, "The Fusion Curves of the System, Naphthalene-phenol," and "The Fusion Surfaces of the System, Naphthalene-chlorobenzene-phenol," the post-graduate work of two of Prof. K. Ikeda's pupils, T. Yamamoto and H. Hirose, are also of high excellence. The paper by Prof. Ikeda himself, on "The Chemical Theory of Solutions," part i., which covers eighty quarto pages, is particularly worthy of attention. It is, in fact, a short treatise which, when part ii. can be added to it, should have publication in book form, so valuable does it appear to be. It is an exceptionally clear exposition of the subject in admirable English, showing marked originality of treatment, fully illustrated by curves, and mathematically discussed, altogether a most interesting paper.

"The Inversion of Cane-sugar," by Y. Osaka; "Complex Ferri-malonates," by M. Matsui; "Constitution of Elæomargaric Acid," by T. Kametaka; "Japanese Oils," by the same; "Ueber den Hauptbestandteil des japanischen Lacks," by Majima and Cho; "Oximes and Imides of Benzenedisulphonic Acids," by T. Suzuki; "Formation of *p*-Oxycarbostyril from *o*-Nitrobenzoylacetic Acid," by K. Matsubara; and "Molecular Re-arrangement of N-Benzylbenzaldoxime," by M. Kuhara, are also interesting contributions.

There is a paper by, like Prof. Kuhara, another well-known chemist, Prof. T. Haga, entitled "A Simple Method of preparing the Imides of the Aromatic Sulphonic Acids," which is a perfect little piece of work of its kind, admirably written. There are still to be noticed two papers by Prof. M. Ogawa which, from their subjects, will be of greater general interest than any other member of this group of Japanese papers, for they seem to establish the existence of two new elements among the metals, *nipponium*, and another not yet named. These papers recently appeared in full in the *Chemical News*. Mr. Ogawa was, two or three years ago, in London, working upon the new mineral, *thorianite*, placed in his hands by Sir William Ramsay. Some of this mineral he took back with him to Japan, where he has discovered other mineral sources of both these elements.

Besides the contents of Sakurai's jubilee part of the Journal of the Tokyo College of Science, other important chemical papers have, from time to time, appeared in that journal, and in English and German journals. But the appearance of this budget of papers on chemical research offers itself now as a striking proof of the remarkable progress which has taken place in the pursuit of chemistry by a nation which, thirty years ago, was nearly ignorant of any significant part of it. That in physics and in the biological sciences the Japanese have equally advanced under similar conditions is, of course, familiar to many of the readers of NATURE.

EDWARD DIVERS.

THE AGEING OF STEEL.

A MEMORANDUM, by Mr. C. E. Stromeyer, the chief engineer of the Manchester Steam Users' Association, just issued, deals with the important question of the ageing of steel, especially that used for steam boilers. It is now twenty-five years since mild steel began to come into use for boilers, and some definite conclusions have been reached as to its behaviour with time. Tensile and bending tests of steel, cut from boiler plates which have been in use for many years, show that the tenacity has remained practically unaltered, while the ductility, as measured by the elongation, has not been affected. It is known that even the best Lowmoor iron boiler plates become brittle with long-continued use, and it is important to know if this happens with steel plates, but no very definite conclusions appear to have been reached, although it was found that the effect of an injury, such as a chisel nick, or a serious deforming pressure, is not an immediate one, except as regards local alteration of shape, but that after the lapse of many weeks the neighbourhood of the injured region gets somewhat brittle.

A very complete account is also given of the causes which produce water-hammer in steam pipes, and the pressures reached in various cases are worked out in some detail, showing very conclusively the superiority of mild steel over cast iron for steam pipes, not only on account of its superior tenacity, but also by reason of its capacity to absorb sudden shock by its elastic and plastic deformation.

NOTES.

WE notice with sincere regret the announcement in the daily papers that Lord Rayleigh, who, accompanied by Lady Rayleigh, left England recently for a tour round the world, has been so ill in South Africa that he has abandoned a proposed visit to Australia, and will probably winter in Egypt. Later reports state that, though his lordship has been seriously ill, he is now much better.

THE one-hundredth anniversary of the birth of Charles Darwin will occur on Friday of next week, February 12. To celebrate this event the New York Academy of Sciences will hold a special meeting on the anniversary day at the American Museum of Natural History. We learn from *Science* that in addition to the presentation to the museum of a bust of Darwin—the presentation to be made by Mr. Charles F. Cox, president of the academy, and the acceptance by Dr. Henry F. Osborn, president of the museum—addresses will be given on Darwin's work in botany, by Prof. N. L. Britton; on Darwin's work in zoology, by Prof. H. C. Bumpus; and on Darwin's work in geology, by Prof. J. J. Stevenson.

WE regret to see the announcement that Mr. W. H. Hudleston, F.R.S., past-president of the Geological Society, died on January 29 at eighty years of age.

PROF. LOUIS MANGIN has been elected a member of the Paris Academy of Sciences, for the section of botany, in succession to M. Van Tieghem, who was elected permanent secretary recently.

DR. ALEXANDER W. PAVLOW, privat-docent in geology in the University of Moscow, has been elected foreign secretary of the Imperial Society of Naturalists of Moscow, and Prof. E. Leyst the curator of the scientific collections of the society.

REUTER correspondents report the occurrence of the following earthquakes during the past few days:—*January* 27, *Messina*.—A strong shock of earthquake, preceded by rumblings and lasting three seconds, was felt at 8 a.m. *February* 1, *Montreal*.—Three distinct earthquake shocks were experienced early this morning, but no serious damage was done.

A REUTER message from Khartum states that Prof. Sayce has discovered the true site of the ancient city of Meroe, about three miles from Kabushia station, near Shendi, which is half-way between Khartum and Atbara. Due west of the Pyramids, near Kabushia, he found on January 16 the great wall of the inner defences and the remains of the Temple of Ammon mentioned in Strabo; also part of the Avenue of Rams, leading up to the temple, and a statue of a king, life size, besides scarabs, seals, pottery, &c., which date from B.C. 700 to A.D. 300.

M. HENRI POINCARÉ was officially received into the French Academy on January 28, succeeding to the place vacated by the late Sully Prudhomme, the poet. An eloquent eulogy on M. Poincaré was pronounced by M. Frédéric Masson, the historian, who, professing ignorance of M. Poincaré's great work in physics, mathematics, and astronomy, proceeded to give an appreciative estimate of Poincaré, the man, accentuating the promise of his boyhood and youth which has been so abundantly realised during manhood.

AT the general monthly meeting of the Royal Institution on February 1, the treasurer announced that the sum of 10,000*l*. has been anonymously and unconditionally placed by a lady at the disposal of the managers for the purposes of the institution. A resolution was passed expressing grateful appreciation of the donor's munificence and discernment, and accepting the gift as a timely and noble recognition of the good public works the institution has done in the past, and is still doing, in the acquisition and diffusion of scientific knowledge, and as an incitement to maintain and extend its usefulness in the unique position which it has occupied for more than a century.

WE learn from the *British Medical Journal* that the French Congress of Scientific Societies will be held this year at Rennes. Among the subjects proposed for discussion are:—the relations of sociology and anthropology; alcoholism—the evil, its causes and remedies; tuberculosis and the means of avoiding contagion; high altitude and seaside sanatoriums; methods and disinfection against contagious diseases, and the results obtained in towns, rural districts, and establishments in which disinfection is practised; the water supply of towns—the contamination of subterranean lakes; leprosy and pellagra in France; the part played by insects, and especially the common fly, in the dissemination of contagious diseases; hygiene of the school child.

A CONVENTION which will include all branches of medical electricity will be held in London on July 5–9 at University College. The exhibition will include all classes of electrical and physical apparatus for medical treatment. It will be held contemporaneously with the convention, and it is hoped that it will give a stimulus to the manufacture of X-ray and other apparatus. Delegates will be present from America and the Continent, and representatives of the various foreign Governments will be invited to take part in a discussion as to the best means of providing apparatus and training for the Army and Navy. The papers and debates will be in English. Papers in French and German will be accepted provided a *résumé* of such papers is sent in English. All papers will be reported either *in extenso* or in abstract in the Archives of the Röntgen Ray. Communications referring to the congress should be addressed to Mr. Ernest Schofield, organising secretary of the X-Ray Convention, 11 Chandos Street, Cavendish Square, London, W.

A SPECIAL point of view of the new Patent Law was referred to by Prof. G. H. Bryan, F.R.S., in a letter to the *Standard* of January 14. Prof. Bryan says the new Act "means that British labour is to be employed in exploiting the brains of German professors subsidised by the German Government, and that the position of the English brain-worker is to be even worse than it has been in the past. There are hundreds of scientific workers in this country who would be only too glad to make and develop discoveries that would bring English industry up to the same high level that has been reached in Germany. Unfortunately, however, their only chance of employment lies in teaching students to pass examinations for salaries often considerably below a living wage, when not one out of a hundred of these candidates will be either competent or in a position to develop any new discovery." While sympathising with Prof. Bryan's plea for increased opportunities for research by men competent and anxious to undertake it, we think he overlooks the probability that British capitalists will learn through the new Act the value of scientific work in promoting industrial developments. The German manufactories introduced into this country as a consequence of the Act should be a striking object-lesson of the connection between scientific research and industrial progress.

AT the first International Congress of Refrigerating Industries, held in Paris last October, the proceedings at which were described in NATURE of October 22 last (vol. lxxviii., p. 644), it was decided to hold the next congress in 1910 at Vienna, and to form an international association, which would give participating countries opportunities of continuing the work begun last year. A meeting was held in Paris on January 25, when delegates were present from thirty-nine countries other than France, with a view to sanction statutes prepared by a specially appointed committee. Some discussion took place as to the seat of the international association, which one of the statutes submitted fixed at Paris. Eventually, according to the *Times* Paris correspondent, all delegates, with the exception of those from Germany and Austria, approved the statutes. Meanwhile, the Germans and Austrians are to consult their Governments, and it is still likely that unanimity may be secured. In the contrary event, the question of holding the second congress at Vienna in 1910 will require some reconsideration.

THE summary of the weather for the week ending January 30, issued by the Meteorological Office, shows that a touch of real winter was experienced during the

period. Over England the mean temperature for the week was from 7° to 9° below the average, and in all the English districts the sheltered thermometers fell below 20°. In the south-west of England and in the Midland counties the lowest temperature was 13°, whilst at Llangammarch Wells the temperature on the grass was 2°. The week was everywhere very dry, and, indeed, the rainfall for the whole of January was much below the average over the whole of England. In London the aggregate rainfall for the month was 0·7 inch, which is less than one-half of the average. At Bath the total measurement was 1·02 inches, which is 1·56 inches less than the average, and at Portland Bill the measurement for the month was only 0·73 inch, which is 1·58 inches less than the normal. At Valencia the deficiency of rain for the month was 2·64 inches. In parts of Scotland the rainfall was in excess of the average. There was a deficiency of sunshine in Ireland during January, but in other parts of the British Isles there was generally an excess.

A REPORT issued by the honorary secretaries of the Aërial League of the British Empire states that the league is making good progress. So soon as possible it is hoped to circulate an official journal and establish a school or college of aëronautics. Arrangements are being made for lectures to be given in all important centres of population in order to interest the public in aërial flight. The purpose of the league is to secure and maintain for the Empire the same supremacy in the air as it now enjoys on the sea; to disseminate knowledge, and spread information, showing the vital importance to the British Empire of aërial supremacy; and to urge these matters upon the nation and upon public bodies and public men throughout the Empire by constitutional means. The league will not favour any one type of airship or any industrial interest. We are in sympathy with the desire expressed in the report that the British nation may take an honourable share in the development of means of aërial navigation. We trust it will be recognised fully by the executive officers of the new league that there is little hope of success of a lasting kind unless the methods of science are adopted from the beginning. The hearty and active cooperation of those men of science who have studied the questions connected with the problem of aërial flight should be obtained at the outset, and their knowledge must be used in determining the forms of activity of the league if national progress in aëronautics is to be secured.

THE record of a trip through the Vedda country of Ceylon, by C. G. and B. Z. Seligmann, forms the subject of the opening and longest article in the number of *Spolia Zeylanica* for December, 1908. Some difficulty was at first experienced in ascertaining whether any pure-bred, cave-dwelling Veddas remain, but, after encountering some half-bred tribes, who dressed (or rather undressed) for the part when the arrival of visitors was signalled, the travellers were finally successful in meeting with the objects of their search, several of whom were interviewed. It is less satisfactory to be informed that the numbers of such folk now appear to be comparatively small. Good descriptions are given of the caves these tribes inhabit. Very curious is the discovery that certain beads worn by some local tribes, by whom they are regarded as semi-sanct, are of Venetian manufacture, and date from the sixteenth or seventeenth century.

THE second number of the Memoirs of the National Museum, Melbourne, is devoted to a monograph, by Mr. F. Chapman, of the Silurian bivalved molluscs of Victoria. Eighteen per cent. of the collection has been identified with species found in other, and frequently widely sundered, areas, the distribution of these ranging in Great Britain through the Wenlock and Ludlow groups, although the German forms occur in the Lower and Middle Devonian. The American types are found in their own home mainly in the Middle Devonian, although one belongs to the upper division of that period. "From this," observes the author, "the inference may be drawn, that since both in Western Europe and Australia the species made their first appearance in the Upper Silurian, the point of dispersal would probably be situated mid-way between those places, provided the conditions were equal, and that there were no barriers to their migration."

THE zoological portion of the imposing building in Singapore known as the Raffles Museum is in the main devoted to the Malay fauna, of the representatives of which a very extensive series of specimens appears to be displayed in the public galleries. To illustrate and explain this collection, the authorities of the museum have just published a guide-book, drawn up by Dr. R. Hanitsch, the director, which is entitled to take high rank among works of this nature. It is, in fact, a concise and popular compendium of the leading elements of the Malay fauna, and ought, therefore, to be of considerable interest to naturalists generally, as well as to the class for which it is primarily intended. The guide is illustrated by twenty-one plates, reproduced from photographs mainly taken by two local gentlemen. While a few of these are devoted to the building itself, the great majority depict the specimens in the collection; these serve to show that in the classes of mammals and birds the series boasts some very fair examples of modern taxidermy, among the most striking being the groups of anthropoid apes and Carnivora.

NOW that attention is centred on Slav politics, the essay by Mr. F. P. Marchant on the Slavonic languages, which appears in No. 53 of the Journal of the Anglo-Russian Literary Society, is certainly timely. It discusses the relationship of the languages spoken by the race, which is divided into an eastern and a western division, the former including Russians (Great, Little, and White), Bulgarians, and Serbo-Croats; the latter Poles, Cecks, Moravians, and Lusatian Wends. The writer, while discussing the inter-relation of these forms of speech, denies that the so-called Palæo-Slavonic is, as has been assumed by some writers, the mother tongue. Another difficulty is the absence of a common syllabary, which can hardly be met by the adoption of the Russian (Cyrillic) alphabet for the whole group. There is a certain but limited degree of affinity between the various subdialects. A Russian scholar in Warsaw or Prague will understand shop-signs and street directions provided he knows the compounds of Latin letters representing certain consonants, and he may occasionally catch the drift of the conversation of persons passing him in the streets. Cecks are sometimes able to understand Russian, but Russians seem generally to fail to understand them. In short, proficiency in one Slavonic tongue does not, we are told, lead to the mastery of others, and the theory held by some Russian students that they know all about other Slav languages is said to be a patent fallacy. It is obvious that this difficulty of intercommunication is a decided bar to that political combination which is now so often suggested. It is much to be regretted that the limited facilities of intercourse between the Slav countries and western Europe have so long prevented the valuable scientific and literary work of these races from gaining the recognition which it deserves. It

may be hoped that our recent political rapprochement with Russia will lead to more study of this important linguistic group, in which much useful work has been done by those scholars whose achievements are recorded by Mr. Marchant.

In connection with heliotropic sensibility, Dr. P. Fröschel contributes to the *Sitzungsberichte der kaiserlichen Akademie der Wissenschaft*, Vienna (vol. cxvii., part ii.), an account of a preliminary experiment to ascertain the presentation period, *i.e.* the shortest time for which a light stimulus must be applied to produce a reaction. The presentation period naturally depends upon the intensity of the light. The author finds that the curve expressing the ratio of the intensity to the presentation period takes the form of a rectangular hyperbola. Working with cress seedlings, a discernible curvature was induced in so short a time as two seconds by a light of 200 candle-power.

A note on the manufacture of ngai camphor from the composite shrub *Blumea balsamifera* is contributed by Mr. P. Singh to the Indian Forest Records (vol. i., part iii.). This variety of camphor is manufactured by the Chinese, and receives from them its designation "ngai." The investigation was prompted by the abundance in certain forest lands of the species noted and *Blumea lacera*, another species emitting a camphoraceous odour. Ngai camphor would not provide a substitute for the ordinary camphor derived from *Cinnamomum camphora*, but has a high value of its own, because the Chinese use it as a medicine and for ritualistic purposes, also in the preparation of fine qualities of Chinese ink.

The new catalogue of microscopes and accessories published by Messrs. W. Watson and Sons, High Holborn, gives full details of their extensive series of microscopes, ranging from the "Van Heurck Grand Model," supplied with various ingenious devices for regulation, to simple types, low-priced but of guaranteed workmanship, suitable for schools. A new model, the "Standard" is announced, in which the fine adjustment is fixed to the side of the limb instead of at the back; also a new portable instrument, that folds up for packing, has been designed. Owing to the success of the new 1/6-inch semi-apochromatic objective with a large working distance, a 1/12-inch oil-immersion objective has been computed on similar lines. The museum exhibition microscope and the Porro erecting prism for dissecting work are ingenious novelties.

In a third part of his studies in root-parasitism, published in the botanical series (vol. ii., No. 5) of the Memoirs of the Department of Agriculture in India, Mr. C. A. Barber deals with the haustoria of *Cansjera Rheedii*. Compared with the types *Santalum album* and *Olax scandens* already described, Cansjera resembles the former, whence the suggestion arises that the genus should be truly assigned to the Santalaceæ. The small, irregular haustoria are supplied with numerous lenticels and covered with warty excrescences, while the corky tissue forms a characteristic white sheath. Internally the haustorium consists of cortical cells, from which the contents pass towards the seat of activity, a transitional region where vascular tissue is formed, and a central core, the source of the penetrating and glandular tissue. For the various points of detail in connection with the method of penetration, the development of an endodermis, and other features the reader must refer to the original.

The fifth part of the fourth volume of the Transactions of the Perthshire Society of Natural Science (1908) contains a number of reproductions from photographs illustrating Mr. H. Coates's presidential address on the glaciation of the county. One of these pictures is here given. The activity of the society extends beyond Perthshire, and the Rev. G. Knight writes on the natural history, geology, and antiquities of Duror, Argyllshire, from the mollusca of Loch Linnhe, through "kentallenite," to Allan Breck Stewart, "a soldier of fortune, a spendthrift, and a prodigal." Mr. G. F. Bates describes the igneous rocks of Glen Lednock, the picturesque valley opening north from Comrie; the successive points in the landscape will be pleasantly recognised by those who have passed over by this route to Loch Tay. Though the paper professedly deals with microscopic details, it is really an account of an excursion, and from this point of view we should like to learn more of the inter-relations of the rocks, especially at their margins, in the field. In an area like this there can be no real distinction between igneous and metamorphic gabbro, such as the author implies on p. 233. Dr. Shand describes crystals of grossularite from Corsiehill Quarry, including a new hexakisoctahedral form. Dr. Lyell directs the attention of members to the mycetozoa to be found near Perth.

View looking up the Sma' Glen from its mouth, showing mounds of fluvio-glacial deposits. Photo. by Mr. A. S. Reid, reproduced in Macnair's "Scenery and Geology of the Grampians."

In the *Cairo Scientific Journal* for November, 1908, Captain H. G. Lyons states that the Nile flood of that year was one of especial interest; the height reached by the river and the volume discharged were above the average for the first time since 1898, although the level was a good deal below the highest recorded at Aswan during the last forty years. This result was due to heavy rainfall in Abyssinia in July, September, and the early part of October. Captain Lyons considers that one of the most promising lines of attack upon the problem of the

Abyssinian rains and the Nile flood is the investigation of the upper air in the monsoon region of the Sudan, whereby the velocity and direction of the air currents at different levels may be determined. The results of observations hitherto made by means of pilot balloons are now being prepared for publication, and will probably show in what direction further efforts should be made. The problem "concerns not Egypt alone, but all countries which depend upon the rainfall of the monsoon winds which flow from the Indian Ocean."

The Humber Conservancy has recently been making experiments with a buoy for lighting the channel of the river in place of the gas buoys or vessels now in use. This buoy has been placed at the disposal of the Conservancy by the International Marine Signal Company. It consists of a generator tube containing carbide, which is floated in a flotation chamber 8 feet in diameter. The gas is generated by the water entering the lower end of the generator and attacking the carbide. This causes a slight gas pressure, which forces the water away from the carbide, stopping the further generation until the gas is used in the lantern, when the water rises again and more gas is made. There is no moving mechanism in the buoy, which draws about 9 feet; the focal plane is 9 feet above water-level. The light is of 340 candle-power, and can be seen at a distance of more than a mile. It shows a flash of about five seconds, and a dark period of four seconds.

Of the many screen-plate processes of colour photography on a single plate that have been proposed and worked at since the Lumière firm, of Lyons, produced their autochrome plate, a very short time ago there was only one, the "Thames" plate, that had reached the commercial stage. We learn from the *Times* that another, the "Omnicolore" of Messrs. Jougla, is now on the French market. We believe that this plate has compound lines, alternating green and red, separated from each other by narrower violet lines. By the use of transparent colours, much more light may be transmitted than in the case of the starch-grain screen of the autochrome plate, with a corresponding gain in brilliancy and shortness of exposure. The new plate has aroused much attention on the Continent, and experimentalists in this country are looking forward to its introduction here.

The December (1908) number of *Ion, a Journal of Electronics, Atomistics, Ionology, Radio-activity, and Raumchemistry*, contains six articles and reviews of seven books. The whole of the articles, of which two deal with applications of the electron theory to the properties of the elements, appear to have been translated from the German by persons unacquainted with the English scientific equivalent of many common expressions. Thus we read about "balls of electricity," "a negative charge unit," "spherical plane," "Peltiere-" and "Halle-effects," "eutechticum," &c. Print and paper are good, and the diagrams show a great improvement on those in the November number.

In the December (1908) number of the *Physical Review* there is an abstract of a paper communicated by Mr. W. P. Boynton to the New York meeting of the American Physical Society in October, on the specific heats of gases. In it the author emphasises the following as a more rational method of treating the subject than is to be found in the standard text-books. If the specific heat of a gas at constant volume be multiplied by the molecular weight we get a quantity we may call the molecular heat. The fraction of this which is due to the translational motion of the molecule is equal to $3/2(\gamma-1)$, where γ is the ratio of the two specific heats of the gas. The product of the molecular heat by this fraction may be called the "translational molecular energy," and ought, according to the kinetic theory of gases, to be a constant for all gases. For forty monatomic and polyatomic gases and vapours considered by Mr. Boynton, it differs from 3 by less than 3 per cent. in forty-five cases.

Messrs. Townson and Mercer have sent us their new double condenser. We have tried this apparatus, and find it a very efficient condenser. It has two double tubes inside the condensing cylinder. The vapour to be condensed is split up into two streams, and passes through two narrow tubes, consequently there is very efficient cooling. The apparatus contains two of these tubes, with two separate inlets and outlets, consequently two distillations can be carried out at the same time with one piece of apparatus. Also two reflux operations can be conducted at the same time. This, however, can only be done if the flasks are of very small size, because otherwise the necks will be too far apart for the tubes to fit in. As a double condenser for distilling two products at once the apparatus is fairly convenient; but for carrying out two reflux operations at once it is not of great use, first, because the flasks must be small, and, secondly, owing to the rigidity of the apparatus. The condenser was designed by Mr. W. H. Rawles.

Bulletin No. 68 of the New Mexico College of Agriculture contains a well-illustrated account of the injurious insects commonly occurring in the region served by the college, with methods for destroying them and for protecting crops against their attack. The instructions are clear and to the point; the bulletin affords a very good example of the work done for farmers by the American colleges.

The current number of the *Journal of Economic Biology* contains an account, by Mr. Graham, of certain hitherto undescribed insect pests affecting cocoa in West Africa. One damages the trees by perforating the bark, and so produces "gumming." Another burrows between the bark and the wood of the branches, arresting the flow of the sap; it has caused a great amount of damage in cocoa plantations of South Ashanti. The cultivation of cocoa has only recently been introduced in this district; the weevil seems originally to have infested the indigenous Papaw tree.

The first number of a new monthly technical magazine has appeared under the title *Leather: Technical and Practical*. It appeals specially to all workers engaged in the leather industries, is edited by Mr. M. C. Lamb, and published by the Leather Trades Publishing Co., 143 Holborn Bars, London, E.C. The dependence of technical processes upon the principles of science is recognised fully, as the titles of some of the articles sufficiently show. Prof. H. R. Procter writes on some unsolved problems in leather chemistry, Mr. S. A. Gaunt gives an account of chrome liquors and their application, and Mr. J. L. van Gijn provides notes on liming of hides for sole leather.

Parts iii. and iv. of vol. xi., and part i. of vol. xii., of "The Proceedings and Transactions of the Nova Scotian Institute of Science, Halifax, Nova Scotia," have been received. The three books deal respectively with the sessions 1904–5, 1905–6, and 1906–7, but have only just reached us. Containing as the books do full and original papers on the geology, botany, and zoology of Nova Scotia by local observers, in addition to researches in chemistry and physics conducted at Dalhousie University, Halifax,

they serve as a convenient record of scientific activity in Nova Scotia. The earliest volume contains an interesting paper, by Dr. A. H. MacKay, on phenological observations in Nova Scotia and Canada during 1904, from which it appears that more than 300 accurate and full schedules of observations were sent in from as many public schools in Nova Scotia, and were referred in groups to a phenological staff for examination, selection, and compilation. This utilisation of the energy of young students of science throughout the province is a hopeful sign for the future of scientific research in that part of the Empire. The same number contains a full account of the edible wild plants of Nova Scotia by Mr. Walter H. Prest, and several papers on the geology of different areas in the province. During the session 1905–6, the flora of McNab's Island, Halifax Harbour, was described by Dr. John H. Barbour, and a catalogue of the birds of Prince Edward Island prepared by Mr. John MacSwain. The fungi of Nova Scotia are being studied by Dr. A. H. MacKay, and a first supplementary list appears in the first part of vol. xii., which also contains notes on the mineral fuels of Canada, by Dr. R. W. Ells. Mr. H. Jermain M. Creighton, of Dalhousie University, contributes numerous papers to these Transactions, among which we notice that on the influence of radium on the decomposition of hydriodic acid.

FROM the Carnegie Institution of Washington, Washington, D.C., we have received a useful pamphlet giving the titles, descriptions, authors' names, &c., of the publications of the institution. The editions of each work are generally restricted to 1000 copies, and bound in cloth, and the prices quoted in the present list refer to the cloth-bound works. The different works treat of a wide range of subjects, among which astronomy, biology, and physics are well represented. All communications respecting these works should be addressed to the institution as above.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN FEBRUARY:—

Feb. 6. 22h. 12m. Jupiter in conjunction with Moon (Jupiter 3° 53′ S.).

12. Saturn. Major axis of Ring = 38″·18, minor axis = 4″·49.

,, 10h. 54m. Minimum of Algol (β Persei).

15. 7h. 43m. Minimum of Algol (β Persei).

,, 8h. 43m. Mars in conjunction with Moon (Mars 0° 1′ N.).

,, Apparent diameter of Mars = 5″·4, Jupiter = 41″·0, Saturn = 15″·2.

19. 9h. 49m. to 13h. 9m. Transit of Jupiter's Satellite III. (Ganymede).

22. 7h. 29m. Saturn in conjunction with Moon (Saturn 2° 52′ N.).

24. 14h. 42m. to 18h. 36m. Transit of Jupiter's Satellite IV. (Callisto).

26. 13h. 5m. to 16h. 26m. Transit of Jupiter's Satellite III. (Ganymede).

27. 6h. 47m. to 7h. 31m. Occultation of 105 Tauri (mag. 5·8).

,, 12h. 42m. to 13h. 31m. Occultation of η Tauri (mag. 5·2).

JUPITER'S EIGHTH MOON.—A telegram from Greenwich, published in No. 4299 of the *Astronomische Nachrichten* (p. 47, January 22), announces that Jupiter's eighth satellite was photographed there on January 16. From two photographs it was found that the daily motion was −16s., +1′, and that the magnitude of the satellite was 17·0. The position determined from these photographs is in close accordance with the Cowell-Crommelin elements.

THE PROBLEM OF SEVERAL BODIES.—In an address delivered before Section A—Astronomy and Mathematics—of the American Association for the Advancement of Science, Baltimore, 1908, the chairman of the section, Prof. E. O. Lovett, gave a valuable *résumé* of the recent progress made in the solution of the problem of several bodies. An abstract of this address now appears in *Science* (No. 733, p. 81, N.S., vol. xxix.).

Commencing with Whittaker's formulation of the classic problem of three bodies, Prof. Lovett proceeds to enumerate, very briefly but very clearly, the results of various attempts to obtain particular solutions and their generalisations. The paper is too comprehensive even to summarise here, but some idea of the thorough treatment the subject receives may be gathered from the fact that it refers to no fewer than ninety-three workers who have contributed to the solution of the problem, and in each case gives sufficient information to enable the reader to see which particular part of the subject each worker attacked.

AN ECCENTRIC VARIABLE STAR.—In No. 4299 of the *Astronomische Nachrichten* (p. 47, January 22) Miss Mary W. Whitney directs attention to the unusual variations lately exhibited by the variable SS Cygni. Since October 3, 1908, the star has varied almost continuously, although irregularly, and at minimum has not fallen to its usual limit; the lowest minimum recorded was about mag. 10·8, the highest mag. 10·5. The maxima, too, have differed from those usually looked for, the brightest being mag. 8·9. The light curves, though irregular, have been rather of the anomalous than of the usual type.

THE MINOR PLANET PATROCLUS (617).—A bi-daily ephemeris for the minor planet Patroclus, of the Jupiter group, is continued by Herr V. Heinrich in No. 4299 of the *Astronomische Nachrichten* (p. 45). This ephemeris extends from January 4 (opposition took place on January 6) to March 19, and the probable magnitude is given as 12·9.

An observation made by Prof. Wolf on January 9 gives a correction of −0m. 39s., +3′·3, to the ephemeris position, and shows that the photographic magnitude is less than 13·0.

DETERMINATION OF THE APEX AND VERTEX FROM THE STARS IN THE PORTER CATALOGUE.—From an analysis of the proper motions of the 1340 stars given in the Porter catalogue, Herr S. Beljawsky has obtained values for the positions of the apex and vertex respectively, which he publishes in No. 4291 of the *Astronomische Nachrichten*. The analysis was made by dividing the catalogue stars into thirty regions, and the final values obtained are:—apex, A = 281°, D = +36°; vertex, A = 266°, D = −24°.

COLOURS OF STARS IN GALACTIC AND NON-GALACTIC REGIONS.—Continuing his investigations of the relationships existing between star colours, spectral class, magnitude, &c., Mr. Franks made an analysis of the colours and magnitudes of 3630 stars, given in the Revised Harvard Photometry, between the north pole and declination 25° S.

As a result of this analysis he finds that the distribution of white and of coloured stars is not symmetrical; there is a striking preponderance of white stars in the galactic, as compared with the non-galactic, regions.

Mr. Franks interprets this result as showing an undoubted physical connection between the colours of stars and the galaxy, and suggests that the latter is probably the newest and most vigorous part of the stellar universe (Monthly Notices, R.A.S., vol. lxix., No. 2, p. 106, December, 1908).

POPULAR ASTRONOMY.—Evidence of the increased interest taken in astronomy by the general public is to be found in the fact that several daily papers now devote space to astronomical news.

From this point of view it is interesting to note that the *Daily Telegraph* of January 27 contained a map of the February sky, with notes on the objects which may be observed; this article is the first of a monthly series. We also remark that the *Yorkshire Weekly Post* is publishing a series of articles by Mr. J. H. Elgie, who in a recent issue directed attention to the possibility of a connection between solar activity and earthquake phenomena.

SCHOOL-WORK AND AFTER-LIFE.

THE problem of bringing school curricula for boys and girls into closer relation with their probable after-school activities has been discussed at recent educational conferences, and I wish to direct attention to three particular cases of the problem:—(1) technical training of boys before apprenticeship to a trade, or attendance at technical institutes; (2) scientific training of boys between ages sixteen and eighteen, preliminary to a medical or engineering course; (3) science teaching of girls with a view to domestic application of the principles and skill acquired.

L.C.C. Conference: Junior Technical Schools.

(1) A session of the London County Council Teachers' Conference was devoted to the subject of junior technical schools for boys. The attendance was large—more than 2200 applications for tickets admitting to the conference having been made to Dr. Kimmins, who was responsible for the organisation of the meetings—and the chair was taken by Mr. F. C. Ogilvie, principal assistant-secretary at the Board of Education for Technology and Higher Education in Science and Art. The chairman said that the present need was a clear statement of accomplishment. The question of the leaving age and the different necessities of localities made the determination of the curriculum a wide problem, so that there could not be a sealed pattern of a junior technical school. Mr. T. Luxton described the system adopted at the Hull Technical Institute, where the boys were admitted after twelve years of age and stayed for two and a half years. Two-thirds attended the commercial side, the remainder the engineering and science side. More than 90 per cent. of the boys came from the elementary schools, and the net effect was to lengthen their school life by about two years.

Mr. F. Jeffery gave an account of the methods adopted at the Stanley Technical Trade Schools, Norwood. Experience at many technical institutions had shown that when a working lad or man returns from a fatiguing day's work he has little energy left to go to a higher school, and the founder of these schools recognised that technical education must begin at an earlier age. Being himself a technical manufacturer, he became convinced that much could be done to develop the originality and skill of boys by taking them *at a compulsory school age* and giving them a taste for practical science and mechanics. He said:—"If we can so prepare our boys that they will be coveted as apprentices by our technical manufacturers, I am sure this will raise the standard of our work." Boys are admitted between twelve and thirteen years of age, and devote half their time to general subjects and half to workshop practice. This system has the economical result that the teaching staff for 300 boys is only that required for 150 in each division, or, in other words, the total teaching staff is not increased by the addition of workshop instruction. The system of fees is unique. The fee for the first year is one shilling per week; those "students" who make satisfactory progress are elected "junior scholars," and pay no fees for the second year. In the third year they may be elected "scholars," and will then be paid a small consideration for their mechanical work if it be of commercial value. Mr. Jeffery claimed that the class-room studies did not suffer in quality, though somewhat restricted in range. His Majesty's inspector reported:—"One justification of the special feature of the school, in devoting half the working time to practical workshop instruction, is seen in the keenness and vigour with which all the work is carried on, and the evident interest which the students take in their studies."

After giving a useful account of the details of this valuable educational experiment, Mr. Jeffery stated the aim of the school to be that of preparing lads to be skilful, scientific, and artistic mechanics, and to make them anxious to continue their studies at polytechnics so as to become skilled artisans fitted for good positions in their industries. When such a result has been achieved, schools of this type are likely to become an integral part of the educational system of the country. Then the status of the British artisan and the standard of his work will be raised.

Mr. R. Bunting would leave trade schools to the polytechnics. The ordinary day school should give such a general education that the children would be prepared to take *immediate* advantage of the special facilities offered by the regular trade schools. From a recent analysis of a record which he had kept of the boys leaving the Acland School (Kentish Town) during the past five years, he found that the boys of greater mental power were also more capable in all intelligent motor exercises, including manual work. Lads liked manual work; such work was specially valuable in cases of slow development, leading to a marked increase in their general mental development concomitant with their growth in skill.

It was well that a conference of teachers should discuss this problem, and it is all to the good that they are endeavouring to link the work in the schoolroom with the after-school employments of their boys, but personally I am convinced that the time is ripe for legislation which should make it illegal to employ young persons unless they are working in the capacity of learners of industry. A recent Act has established this principle for Scotland—why should England lag behind?

Preliminary Scientific Instruction of Medical and Engineering Students.

(2) The General Medical Council refuses to recognise the leading secondary schools as places where the preliminary training in chemistry and physics may be given to medical students, notwithstanding the fact that the Conjoint Board of Physicians and Surgeons grants such recognition. It is alleged that the council wishes the students to learn "medical chemistry" and "medical physics." As already reported in NATURE of January 21, the Public Schools Science Masters' Association condemned the action of the General Medical Council, as boys have been removed from school in consequence of the non-recognition stated above, although it is not clear that this non-recognition by the General Medical Council is of the slightest practical consequence. During the debate the wider issue was raised as to whether a boy intended for a scientific profession should leave school at seventeen or remain another twelve or eighteen months and devote his main energies to science studies. Prof. Armstrong spoke in favour of compelling all boys to leave school at seventeen, but the majority of those present were of the opposite opinion. Nothing was said about the boys who reach the age of seventeen without reaching the position in the school appropriate to that age; but, unfortunately, such cases are far from rare, and it is, in the writer's opinion, very dubious policy to keep such youths longer at school; transplanting offers the better chance of growth; but for the abler and more industrious the age of seventeen is a critical period in mental development. At this epoch the boy has begun to feel his feet, to take his stand on general scientific principles, and sees before him an inspiring and unlimited vista of future study. Is it advisable to remove him at this moment from the instructor whom he understands, and who understands him? Is it prudent to exchange the individual tuition with constant questioning and supervision, the homely apparatus which does not obscure the idea and purpose of its construction, for the large classes, the diminished or evanescent tutoring, the elaborate lecture appliances of the technical college? Moreover, it is necessary to consider how far the youth is matured in character, as the possibility of a wrecked career is not negligible when a youngster has to be sent from a boarding-school and a country home to live as a medical student in London or in a great industrial city.

On the other hand, it has been urged, and Prof. Armstrong stated this view as a result of his personal observation, that character is strengthened by removing the youth of seventeen from too tender tutelage, and that the prolongation of such tutelage hinders the growth of resourcefulness, initiative, and self-reliance. To the writer it seems necessary to distinguish between two parallel courses:—(*a*) public school followed by Oxford or Cambridge; (*b*) town school followed by day college, with residence at home. The transfer from school to college may perhaps be a year earlier for (*b*) than (*a*). It is worth pointing out that high academic distinctions often bring a rich reward in later years, and that to shorten the course

before the degree is to pit a man against competitors a year older.

As regards "medical chemistry" or "medical physics," it should be stated, clearly and with emphasis, that we want students to be grounded in the fundamental principles of chemistry and physics, and that "medical physics" is an utter delusion. A competent teacher will use such illustrations as will bring his teaching into close relation with the interests and ambitions of his pupils, whether medical, engineering, or other. Only in this sense can we allow any branch of science to be "medicated."

Domestic Training and Science for Girls.

(3) The Incorporated Association of Assistant Mistresses in Public Secondary Schools devoted the afternoon of their twenty-fifth annual meeting to a discussion of the science curriculum for girls. Miss Laurie (Cheltenham Ladies' College) read a paper dealing with the principles to be followed in planning a science course. They wanted to train children in scientific method and management; they should not cram facts, but develop faculties. Much depended upon proper grading of experimental work, and it was important to use simple apparatus. There was a danger of providing technical education without a scientific training. This led to the British workman being beaten by the German.

Miss Wood (Leeds Girls' High School) described a course of "science applied to domestic life" which had been carried out at Leeds. In addition to laboratories for chemistry and physics, the school possessed a "kitchen laboratory." Her object was to make common things and ordinary phenomena the very centre of the teaching, to develop scientific principles, and inculcate the scientific habit in the closest possible connection with the facts of everyday life. The household, and above all the kitchen, abounded in things and problems that could be made the object of simple scientific inquiry; their study stimulated the interest of girls. For a home task Miss Wood had set high-school girls to clean the flues of the kitchen range, light the fire, and arrange to have the water hot. In that sort of way the cooperation of home and school was secured.

During the discussion which followed several speakers feared the danger of making scientific instruction too utilitarian; the domestic training might be acquired at the expense of, and not in addition to, the training in exact thinking.

So great a majority of girls will become better and more efficient women by acquiring domestic knowledge and skill, and the spread of such acquirements is so important to national physique, that there can be little hesitation in encouraging domestic training in our girls' schools—it being obvious that in very many cases the home cannot meet the need; but in actual laboratory work the choice of subject and method must have unity of aim. Which is to be the dominant ideal in the teacher's mind? Some experience of girls' schools, and a careful observation of the plan pursued in some of the most successful technical classes, lead me to suggest that it will be found best to develop a *science* course, using domestic phenomena for illustrations wherever suitable, to be followed in the last year by a course frankly and directly aiming at *domestic* training, parallel with, or in place of, the science course. This would mean that science and domestic training would be correlated, but have separate places in the time-table.

G. F. D.

A PROPOSED NORTH POLAR EXPEDITION.

AT the meeting of the Royal Geographical Society on January 25 Captain Roald Amundsen read a paper explaining his plans for a proposed north polar expedition. Mr. Amundsen urges the necessity for another crossing of the Arctic Ocean, not merely in order to gain further knowledge of the ocean itself, but to study the general problems of oceanography with the greatly improved methods which have come into use since the date of the *Fram* expedition, under the favourable conditions of an ice-covered sea, which gives a fixed undisturbed surface from which to work. He brings forward in his paper many interesting examples of the progress which has been made during the last twelve years in improving the apparatus and methods of deep-sea investigation, and many arguments in support of his contention that the polar ocean offers unequalled opportunities for settling vexed questions connected with the cause of currents, the effects of tidal action, the reciprocal action of plants and animals at various depths, and so on. A thorough examination of Nansen's old ship, the *Fram*, has shown that the vessel is, or can easily be made, as sound as ever, and fit for another voyage similar to that of the famous expedition of 1893–6.

The plan of the expedition is stated as follows:—"With the *Fram* equipped for seven years, and a capable crew, I shall leave Norway in the beginning of 1910. We shall make for San Francisco round Cape Horn, taking in coal and provisions at the former place. We shall then shape our course for Point Barrow, the most northerly point of North America, which I hope to reach by July or August. From this place the last news will be sent home before the real voyage begins. On leaving Point Barrow it is my intention to continue the voyage with as small a crew as possible. We shall then make for the drift-ice in a direction north by north-west, where we will then look for the most favourable place for pushing farther north. When this has been found we shall go as far in as possible, and prepare for a four or five years' drift across the Polar sea. Throughout our voyage up to this point, I intend to make oceanographic observations; and from the moment the vessel becomes fast in the ice, a series of observations will be begun, with which I hope to solve some of the hitherto unsolved mysteries. What I expect to find in the unknown part of the Polar sea I will say nothing about at present. Some people have put forward theories of great masses of land, others of small. I ought perhaps also to have put forward my theory, but think it wiser to refrain from doing so until I have investigated matters at closer quarters."

THE GEOLOGICAL SOCIETY OF GLASGOW.

THE jubilee of the Geological Society of Glasgow was celebrated on January 28, when a conversazione was held in the University of Glasgow. An address was delivered by Sir Archibald Geikie, K.C.B., president of the Royal Society, and now the senior member of the Glasgow society. Prof. J. W. Gregory, F.R.S., the president, said the Geological Society of Glasgow has been fortunate in its roll of distinguished members. For twenty-two years the late Lord Kelvin was its president. The name which has been longest on the list of members is that of Sir Archibald Geikie. In 1862 he read to the society a paper which occupied three-fourths of the first volume of the Transactions, and at once lifted British glacial geology on to a new plane.

Sir Archibald Geikie, during the course of his address, said it was not until some fifty years ago that the number of men following a geological bent grew large enough in Glasgow to call for the formation of a geological society. It is a curious fact, he said later, that some of the earlier writers on Scottish geology were foreigners, some of them having been attracted to this country by the fame of the wonders of Staffa and the Western Isles. One of the earliest and most celebrated of these visitors was the Frenchman Faujas de Saint-Fond, who in the year 1784 travelled from the south of France to see the marvels of Fingal's Cave. On his way back from the West Highlands Faujas de Saint-Fond passed through Edinburgh, and met there the illustrious James Hutton, who, he tells us, "was at that time engaged, in the calm of his study, writing a work on the theory of the earth." Little could the French traveller have divined that "this modest philosopher," as he called him, would in after years be universally acclaimed as one of the great founders of modern geology. In the year 1819 there appeared the monumental "Description of the Western Islands of Scotland," by John Macculloch, in

which was given an excellent account of the Clyde islands. Contemporary with Macculloch was another observer to whom Scottish geology stands deeply indebted, Ami Boué. After taking his degree in Scotland Boué went to Paris, where for a time he employed himself in preparing his "Essai géologique sur l'Écosse," which saw the light in the year 1820. A few native inquirers began to make their appearance during the closing years of the eighteenth and the early decades of the nineteenth century as pioneers in the investigation of the details of the local geology. First came David Ure, whose excellent "History of Rutherglen and East Kilbride," published in 1783, stands out pre-eminent for the fulness and faithfulness of its descriptions. Afterwards came Andrew C. Ramsay. After referring to the work of John Craig in Lanarkshire, Montgomery in Renfrewshire, Prof. Thomas Thomson in Glasgow University, and James Bryce, Sir Archibald Geikie said that of all the influences which conspired to raise in Glasgow an interest in the geological history of the district he was disposed to give the foremost place to that of James Smith, of Jordanhill.

THE WINNIPEG MEETING OF THE BRITISH ASSOCIATION.

A CIRCULAR has been prepared containing information of interest to members of the British Association who propose to attend the meeting to be held in Winnipeg, Manitoba, Canada, in August next, under the presidency of Sir J. J. Thomson, F.R.S. A representative local executive committee and officers have been appointed to conduct the local arrangements, which will include some interesting excursions and facilities for a tour through the Western Provinces to the Pacific Coast. The weather conditions during the latter part of August and the beginning of September are favourable in the Western Provinces of Canada, whilst in Winnipeg, situated 760 feet above sea-level, the days are warm, though not oppressively hot, and the nights are invariably cool. On account of August being the busiest month of the year in bookings to America, no reduction on minimum steamship rates will be made to members of the association, but superior accommodation may be granted, on the return voyage, at the ordinary minimum rate. The journey to Winnipeg, the meeting, and return home will take about thirty-two days. There will be a western excursion from Winnipeg to Regina, Moose Jaw, Calgary, Edmonton, Vancouver, and Victoria, and return to Winnipeg; members who take part in this excursion will require ten more days, thus making a six weeks' visit. Special fares are expected to be in force on the Canadian railways, amounting probably to a single fare for the return journey, from Montreal to Winnipeg, provided the party numbers not less than fifty; as also from Winnipeg to Vancouver, or for any side-trip made by individual members. The estimated personal expenditure of each member attending the meeting from Great Britain is a minimum of about 38*l*., and an average of about 65*l*. The additional expense of the western excursion will be about 25*l*. Any member of the association who contemplates an extensive journey of exploration or for other scientific purposes, fishing, hunting, &c., is invited to communicate with the local secretaries of the British Association, University of Manitoba, Winnipeg. Expert advice and assistance will be given to any group of members who propose to avail themselves of this opportunity. A list of hotels and lodgings will be issued by the Winnipeg executive officers, to whom application should be made, early in July.

Members who propose to attend the meeting should send in their names to Mr. H. C. Stewardson, assistant treasurer of the British Association, Burlington House, London, W., not later than May 31, by which date members should, if possible, complete their arrangements with the steamship companies, as all the best accommodation on steamers sailing in August is booked some months ahead. An illustrated handbook of preliminary information, issued by the Winnipeg executive committee, will be forwarded from the office of the association on receipt of 2½*d*. for postage.

MECHANICAL FLIGHT.[1]

Present Position.

THE recent records made by Messrs. Wright, Farman, Delagrange, and Bleriot, together with the gradual accumulation of testimony in favour of mechanical flight, have finally disabused both the public and experts of the notion that aviation is a dream.

Many engineers from time immemorial have tackled the subject without success, and there was every reason for the sceptical attitude which has prevailed until the last few years. It is now evident that mechanical flight was impossible before science and engineering skill in the nineteenth century had so perfected the heat engine that considerable power was obtainable with but little weight. The present improved aspect of affairs must not, however, blind us to the fact that much has yet to be done. The most successful machines now in existence show serious defects, cannot be manipulated in troublesome weather, and have every part so light that at all times they are on the brink of collapse. It rests with mechanical engineers to design a stronger machine without losing efficiency. In the course of this paper the author proposes to indicate certain points in which improvement is desired, and at the same time he has endeavoured to include a sufficiency of the theoretical and experimental knowledge available on the subject to enable a would-be aviator to construct a simple type of machine.

It cannot be too strongly realised that existing information is defective, and a few words as to research may be useful.

Necessity for Research.

It will be shown in the course of this paper that the whole question of mechanical flight depends upon a knowledge of the manner in which air reacts against solid bodies moving through it. A large number of researches have been made during the past 150 years, but even yet exact information is lacking on the majority of points.

Furthermore, mathematical analysis has not been sufficiently developed. A few great mathematicians (including Lords Kelvin and Rayleigh) have devoted some attention to the matter, but the author is not aware that any mathematician worthy of the name has considered it worth while to make an exhaustive study of the question, although it must be recognised that the recent advances in the theory of hydrodynamics form useful auxiliaries to the study of aërodynamics.

Brief History of the Theory.

The nature of fluid resistance has been investigated for many years, and the general principles are to be found in Newton's "Principia." The ballistic researches of Hutton and Robins at the end of the eighteenth century first clearly showed the quantitative value of air resistance, and their work is still valuable. On the hypothesis deducible from Newton's work, Messrs. Navier and Gay-Lussac early in the nineteenth century formulated a theory of flight which showed that great power was necessary, and this notion held sway for many years after, so that little progress was made with the subject, flight being deemed impracticable. Experiments by Wenham and Browning in the 'eighties, together with Langley's researches in America and Maxim's in England, clearly showed the fallacy of this idea. Pénaud in 1876 first gave the mathematical theory of the aëroplane, which had been conceived by Henson in 1840. The late Mr. Froude, Lord Rayleigh, and Prof. Bryan developed this theory, and in 1903 the last-named produced equations of stability for the aëroplane. Two years later Captain Ferber, of the French artillery, amplified these equations to find the conditions of lateral stability and the form of the trajectory, and quite recently Mr. Lanchester has done similar work. Prof. Fitzgerald and Lord Rayleigh have given some attention to the ornithoptère, and Profs. Pettigrew and Marey at an earlier date arrived at several important conclusions respecting bird flight. The helicoptère has not received very much attention, but the cognate work of the late Mr. Froude and his son on propellers has a most important

[1] Abridged from a paper by Mr. Herbert Chatley read before the Society of Engineers on December 7, 1908.

bearing on the matter. Mr. Alexander, Sir Hiram Maxim, and several other engineers have made researches on the subject of air-propellers.

Theory.

Resistance of Surfaces and Solids.[1]—A certain resistance is experienced when any body is moved through the air, depending on the form of the body and the relative speed. If the air is abruptly parted the sudden alteration of its relative momentum causes a thrust on the body; its friction against the body produces further resistance, and the partial vacuum at the rear (due to the air not immediately returning) causes still more resistance. The air enters this rear space in a series of whirls or eddies, the kinetic energy of which must be supplied by the moving body. Hence we must consider the front form, the surface, and the rear form of the moving body. All the effects are, at the speeds commonly occurring, nearly proportional to the square of the speed.

If a thin but rigid plane be moved perpendicularly to itself with a speed of V feet per second, it will be subjected to a dynamic resistance and also to a negative pressure due to the whirling behind. The skin resistance will be negligible except when the dimensions are very great. The dynamic resistance depends on the quantity of air affected, which again varies with the area, so that we may write

$$P=k\left(1+\frac{1}{n}\right)SV^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where P is the total pressure in lb., S is the area in square feet, V the speed in feet per sec., and k and n are constants; k is the mass of a cubic foot of air divided by 2, and is equal to about 0·0012 at normal temperature and pressure; n is the ratio of the dynamic to the negative pressure, and is generally rather more than 2, so that $k\left(1+\frac{1}{n}\right)$ varies according to different experimenters from 0·0013 to 0·0017. Langley's value 0·0017 is frequently used, so that we have

$$P=kSV^2 \text{ (where } k=0{\cdot}0017) . \quad . \quad . \quad . \quad . \quad (2)$$

If the plane be turned so that it make an angle γ with the direction of motion, the dynamic action is no longer symmetrical, skin friction becomes important, and negative pressure decreases. Many rules have been given for this case, but except for very small (say less than 2°) and very large angles (more than 40°) the following rule will serve:—

$$P=2kSV^2 \sin \gamma \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

As the surface becomes nearly coincident with the direction of motion P decreases, but there is a certain residual resistance due to edge dynamic action and skin friction. Lanchester makes this approximately

$$F=\frac{2kSV^2}{20} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

where F is the total resistance in lb.

(The author is responsible for this formula.)

This means that the coefficient of skin friction is upwards of 5 per cent. of the coefficient of resistance. There is some difference of opinion as to this, but the value will serve.[2]

Curved surfaces experience analogous resistances when inclined so as to present a *definite* convexity or concavity forwards, the coefficient being rather larger. If such surfaces have their chords in the direction of motion, they will be subject to skin friction, and will also experience an upward or downward thrust according as the convexity is beneath or above, provided that the curvature is easy so that the air may stream into the concavity. Surfaces laterally great experience more thrust than those the major dimensions of which are in the direction of motion, the ratio of thrust per unit area varying about 30 per cent. above and below that on a square surface.

The resistance of air to solids in motion is similar to that of water, but in the decreased ratio of the density of air to water (about 1 : 800).

[1] See Lamb's "Hydrodynamics," Lanchester's "Aerodynamics," also an article by the author on the "Stream Line Theory in Relation to Aerodynamics," in *Aeronautics*, August, 1908.

[2] See Baden-Powell's "Practical Aërodynamics," Langley's "Experiments in Aerodynamics," and the author's book, "The Problem of Flight."

Centre of Pressure.

The dynamic resistance is not symmetrical, the resultant pressure being ahead of the centre of area. More information is required as to this displacement. For planes inclined at an angle γ to the direction of motion, the following rule, given by Joëssel and Avanzini, is much used:—

$$\Delta=0{\cdot}3(1-\sin\gamma)L \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

where Δ is the distance in feet from the centre of area to the centre of pressure, and L the length in feet of the plane in the direction of motion.

Turnbull (*Phys. Review*, xxiv., March, 1907) contests this rule, and states that his experiments indicate that when γ is less than 18°, Δ simply varies with γ, so that when $\gamma=0$, $\Delta=0$. For surfaces having a convex underside or concavity in front and convexity at the rear (both on the underside), he gets a law similar to, but in excess of, Joëssel's. He maintains that these two types of surface only are stable.

As this quantity enters into all the stability formulæ, further experiment is urgently required.[1]

Energy Required for Flight (Aëroplane).

Since the normal pressure varies as the area of the plane and the square of the speed, the component of this in the direction of motion will similarly vary. Thus if the

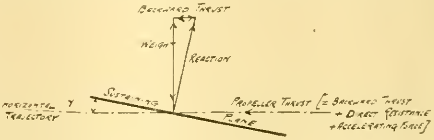


FIG. 1.—Equilibrium of Forces in Aeroplanes: Aëroplane Running Horizontally.

thrust is in the direction of motion we have R the resistance of the plane in lb.

$$R=P \sin \gamma=2kSV^2 \sin^2 \gamma \quad . \quad . \quad . \quad . \quad . \quad (6)$$

and if a further resistance CV^2 be allowed (where C is the projected area in square feet of the car at right angles to the direction of motion) for the car and framework, we have

$$\begin{aligned} H &= (R+CV^2)V \\ &= (2kS \sin^2 \gamma + C)V^3 \quad . \quad . \quad . \quad . \quad . \quad (7) \end{aligned}$$

where H is in foot-pounds per second.

Hence the power required appears to vary as the cube of the velocity. γ, however, is not necessarily constant,

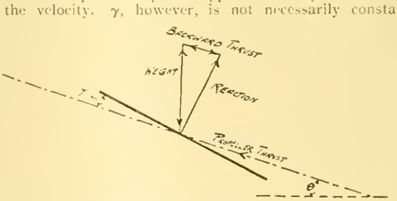


FIG. 2.—Equilibrium of Forces in Aëroplanes: Aeroplane Ascending.

so that we may diminish the power by decreasing γ, always remembering that C is invariable. The limiting value of γ is determined by the weight, for the vertical thrust must never be less than the weight. If the direction of motion is horizontal, then we have

$$W=P \cos \gamma=2kSV^2 \sin \gamma \cos \gamma \quad . \quad . \quad . \quad . \quad (8)$$

where W is the weight in lb., so that V being known, γ can be computed, or *vice versâ*. It will follow from this that if a certain starting value for γ is assumed, the value V, found from equation (8), will be the lowest soaring speed, *i.e.* the starting speed required.

[1] See Turnbull's paper, also Kummer, "Berlin Akademie Abhandlungen," 1875–6; Joëssel, "Génie Maritime," 1870; "Langley, "Experiments in Aerodynamics"; Moedebeck's "Pocket-Book."

By substitution between (7) and (8) the speed corresponding to a given power and angle may be obtained, or the power required to drive the machine at any particular angle and speed. If the machine be rising, so that the

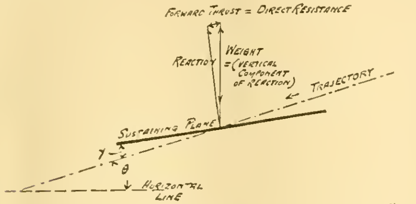


FIG. 3.—Equilibrium of Forces in Aëroplanes: Aëroplane Descending (gliding).

line of motion is inclined at an angle θ to the horizon, then (8) becomes

$$W = P\cos(\theta+\gamma) = 2kSV^2\sin\gamma\cos(\theta+\gamma \quad . \quad . \quad (9)$$

By substitution between (7) and (9) we can find the power,

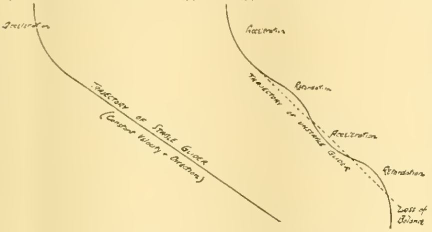


FIG. 4.—Trajectories of Stable and Unstable Aëroplanes.

speed, and angle in terms of one another in the new circumstances, which are the most adverse that have to be considered.

Power Required for a Helicoptère.

This will follow at once from a consideration of propeller thrust. For if T be the thrust in lb. of a propeller, under given conditions as to speed and slip, then in a helicoptère

$$W = nT \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

where n is the number of propellers.

The ornithoptère will be discussed later.

Efficiency of Propellers.

Experiment has generally shown that, subject to correction for the difference of density, an air propeller is almost identical in its action with a marine propeller. The thrust is proportional to the area of the blades and the square of the speed, and the power varies as the cube of the speed. There is a diminution of thrust with a decrease of slip, and both power and thrust increase with the diameter of the propeller. There is no necessity to present here the general conclusions as to propellers, which will be found in Mr. Froude's papers in the Trans. Inst. Naval Architects, and in text-books on naval architecture and marine engineering. There is, however, one respect in which the action of a propeller in air differs from that in water, viz. the feed. Owing to the small inertia of air, a propeller, revolving on a fixed axis in air previously stationary, rapidly ejects air by axial propulsion and centrifugal force, and tends to surround itself by a vortex of air, with a consequent diminution of the thrust to almost zero. This is the reason for the lack of success in experiments which have been made on lifting screws for helicoptères. On the other hand, an axial or transverse flow caused by motion of the axis of rotation will supply the propellers with the necessary fresh air, and consequently we find that the smaller the slip (*i.e.* the greater the advance) of the screw the greater its efficiency. Similarly, in helicoptères moving laterally there is more lift.

For a sustaining screw not rising (*i.e.* with 100 per cent. slip) the author has deduced the following formula for the thrust (see "The Problem of Flight," p. 9):—

$$T = 0{\cdot}1r\sqrt[3]{HD^7} \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

where T is the thrust in lb., r the revolutions per second, H the horse-power, and D the diameter in feet of the propeller. This is based on the assumption that the area is that required by the conditions as to power, diameter, and speed. The following rule for the projected area must be applied:—

$$A = \frac{4}{\pi r}\sqrt[3]{\frac{H}{D^5}} \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

where A is the ratio of the projected area to the disc area.

These rules are based on Mr. W. G. Walker's experiments with fans, particulars of which will be found in Mr. Innes's book on "The Fan."

The thrust per horse-power obtained with the best forms of propellers varies from 20 lb. to 60 lb., 40 lb. being the common maximum. The mechanical efficiency, as in the case of marine propellers, rarely rises above 50 per cent., the best results being obtained with a minimum of slip. This alone gives the aëroplane a superiority over the helicoptère.[1]

Stability of Gliders.

We have seen that the centre of pressure is ahead of the centre of area, and that the distance between these two depends on the angle γ. If then the angle and the normal pressure are constant, the turning moment of the pressure about the centre of area is also constant, and may be balanced by shifting the centre of gravity until it lies over the centre of pressure. Seeing, however, that neither the angle nor the resistance is absolutely constant, it might be supposed that stability was impossible. That this is not so has been demonstrated by Prof. Bryan and Mr. Williams in a paper read before the Royal Society in 1903, and by Captain Ferber in an article in the *Revue d'Artillerie* (November, 1905). In the latter it is shown that an aëroplane is longitudinally stable if two conditions are satisfied.

(1) That the longitudinal radius of gyration about an axis through the centre of gravity does not exceed

$$\sqrt{\frac{P}{37b}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

when P is the weight of the aëroplane in kilograms, and b the overall width of the machine in metres. The radius of gyration is here measured in metres.

(2) That the centre of gravity falls over the centre line between two points, one a little ahead of the centre of area of the sustaining surfaces, the other near the forward edge of the aëroplane. The exact values of these positions depend on the characteristic magnitudes of the machine through a series of somewhat complex equations, for which the papers referred to should be consulted. It must be recognised in this connection that the probable inaccuracy of Joëssel's formula invalidates the accuracy (*not* the method) of the values given by Captain Ferber in this paper.

If the centre of gravity coincide with one of these points, the machine is subject to two oscillations of long and short periods respectively, any increase of which will lead to collapse.

The behaviour of a machine running with a certain initial speed is then somewhat as follows. The continued resistance tends to retard the machine, and to cause the velocity to fall below the soaring limit, and the weight (in front of the centre of area) causes the front to dip. The gravitationally acquired velocity causes a forward acting pressure on the surface, so that if the machine is stable (in accordance with the above conditions), it settles down into a condition in which the resistance due to the resultant velocity just balances the component of the weight in the direction of motion. Pénaud has shown that the angle between the plane and the direction of motion (trajectory) (*l'angle d'attaque*) is half the angle between

[1] See the author's paper to the Aëronautical Society, October, 1908.

the trajectory and the horizontal when the trajectory is such as to give the greatest travel.

This condition is satisfied when

$$\tan\gamma = \sqrt{\frac{C}{2kS}} \quad . \quad . \quad . \quad [\text{see } (7)] \quad (14)$$

If from any cause the machine loses velocity, it will drop and gain kinetic energy by loss of potential, until its velocity is that required. On the other hand, if accidentally its velocity increases, it will rise, to lose kinetic energy by gaining potential energy. It is this exchange in the form of energy which causes the oscillations in an unstable glider. Prof. Bryan and Mr. Williams have photographed gliders bearing flash-lights, and demonstrated the reality of the long- and short-period oscillation, but the theory needs considerable amplification so as to apply to complex cases of combined planes, and simplification so as to be readily applicable to design.

Mr. Lanchester ("Aërial Flight," vol. ii., and British Association Trans., Dublin, 1908) gives new formulæ for the stability, and finds that the oscillations are trochoidal.[1]

Practice (Aëroplanes).

Time will not permit an exhaustive account of the theoretical principles involved to be given, but the more essential points have been touched upon, and it will be useful to indicate how these principles will be applied.

In designing an aëroplane the weight is perhaps the first consideration, and next the minimum velocity required. From formula (8) we can proceed to find S, the area.

$$W = 2kSV^2 \sin\gamma \cos\gamma \quad . \quad . \quad . \quad . \quad (8)$$

Let $\cos\gamma = 1$, since γ is small, and $\sin\gamma = \frac{1}{3}$, and $2k = 0{\cdot}004$,[2] then

$$W = 0{\cdot}0012\ SV^2,$$

and

$$S = \frac{W}{0{\cdot}0012\ V^2} \quad . \quad . \quad . \quad . \quad . \quad (15)$$

Thus, if V is 30 feet per second (say thirty miles per hour), S = W, *i.e.* the area in square feet is the same as the weight in lb. Less area will necessitate more speed, and *vice versâ*.

A useful rule connecting the area and weight (based on bird flight in spite of dimensional theory) is that

$$S \propto W^{\frac{2}{3}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (16)$$

Next, to find the thrust required, we take formulæ (7) and (8), and get

$$\frac{T}{W} = \frac{R + CV^2}{W} = \tan\gamma + \frac{C}{2kS \sin\gamma \cos\gamma} \quad . \quad . \quad (17)$$

as the ratio between the thrust and the load. Neglecting the second term, which is small (or rather, taking a higher value for the first, so as to include the second), we write

$$\tan\gamma = \sin\gamma = \tfrac{1}{3} \text{ or } \tfrac{1}{4},$$

so that

$$T = \frac{W}{3 \text{ or } 4} \quad . \quad . \quad . \quad . \quad . \quad . \quad (18)$$

Since the thrust per B.H.P. with a good propeller is about 30 lb. or 40 lb., we may write

$$40H = \frac{W}{4},$$

so that

$$W = 160H \quad . \quad . \quad . \quad . \quad . \quad (19)$$

where H is now in B.H.P.

This may be regarded as a high value, and probably only half this can be safely employed, so that 1 horse-power will carry, say, 80 lb. Great improvements should eventually be made in this direction.

The light motors (such as the Antoinette, Dufaux, and Esnault-Pelteric types) now made produce about 1 B.H.P. per 3 lb. of weight, or allowing for transmission gearing and friction losses, say 1 B.H.P. per 5 lb. of mechanism, so that the weight of this will be $= 5$ H lb., and hence from (19) (modified as suggested) we get the available weight of the surfaces, framing, and aëronaut $= 75$ H lb., or for framing and surfaces alone (reckoning aëronaut's weight at 150 lb.)

$$W = (75H - 150)\ \text{lb.} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (20)$$

Employing the rule obtainable from (15) that S = W, we find the weight of surfaces and framing per square foot is

$$\frac{W}{S} = \frac{75}{80} - \frac{150}{S} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (21)$$

Care must be taken to prevent surfaces interfering with one another, and this is generally attained by superposing them at a distance apart equal to their width, or placing them behind one another at the same minimum distance.

The positions of the aviator and the engines are very important. Generally the first is in front. The Wright machine has them side by side. In any case the position of the common centre of gravity must answer to the rules given in the theory of stability. Lateral balance is assured by the use of a dihedral angle between the wing planes or by a keel plane. Captain Ferber has discovered the laws controlling the size and position of the latter, which are to be found in the paper previously referred to. Steering is accomplished in several ways, as will presently be described.

Constructive Features.

Several types of machine may be distinguished, but three especially are noteworthy, and are named after their inventors:—(*a*) Chanute; (*b*) Langley; (*c*) Wright. The Phillips machine is a fourth type, but is analogous to the first. The *Chanute machine* is the type adopted by Farman, Delagrange, and Captain Ferber. It consists of two superposed, narrow surfaces mounted on a transverse girder. A central longitudinal girder connects this front frame with a rear one of similar form, but smaller, sometimes divided by partitions into cells after the pattern of the Hargrave kite. The aviator and motor are placed centrally at the rear of the front surfaces, where the c.g. must be, so as to be ahead of the mean centre of area of all the surfaces. The trimming planes are generally in front, and the steering planes at the rear. This differs, however, and will be discussed presently. One propeller is used between the sets.

The *Langley type*, generally termed monoplanar, consists of two pairs of wing surfaces, inclined $67\frac{1}{2}°$ from the vertical, so as to include a dihedral angle of 135°. A central shaft, or framed girder, supports the cantilever ribs which stay the wings. The engine is between the pairs of wings, and the two propellers are paired alongside.

Wright type.—Consists simply of two superposed surfaces as in the Chanute type, with no tail. Front trimming planes similar to the main wings, and rear vertical planes for steering. Catapult initial propulsion. Two propellers behind the wings.

Trimming and Steering.

Guide planes of various forms are used for trimming and steering. A cruciform set of planes for both purposes has been used on the Langley and Ludlow machines. Superposed pairs for trimming, placed in front, have been used by Farman, Delagrange, and the Wrights. Santos Dumont (xiv., *bis*) employed a cellular kite for both purposes, and M. Bleriot has used trimming planes, turning on axes, at the tips of the wing planes. A sliding weight is used in the Weiss gliders, and the author has suggested a weight on a coarse-pitched leading screw as useful. For steering laterally, vertical surfaces are generally employed at the rear. By slightly canting the machine a lateral thrust is produced which will turn the machine, although the consequent diminution in lift tends to make it lose elevation.[1] The Wrights also employ torsion of the main surfaces.

Starting and Alighting.

In starting an aëroplane there are numerous difficulties. The essential is that the soaring velocity shall be reached before the machine leaves the ground. If a machine be simply propelled along a track, so soon as the soaring velocity is approached the friction on the ground becomes negligible, and the propulsive effort is uncertain. Usually

[1] See the *Engineer*, September 18, 1908.

[2] Twice 0·0017 (see p. 414) plus an addition of 0·0006 for the lateral spread generally employed.

[1] See paper by M. Renard in *Comptes rendus*, 1908.

the machine rears or sinks forward, touches the ground, and loses its required velocity, so that no start is made. Langley experienced great difficulties in this way. Four methods are available.

(1) Starting on a track which the aëroplane cannot leave until the required velocity is reached. (Langley.)

(2) Starting on a track employing a small plane angle, and when a velocity has been reached in excess of the minimum for the machine, raise the planes quickly until the angle suits. The excess of speed will give the initial elevation required. (Farman, Delagrange, Ferber.)

(3) Start from a height, preferably down a slope. (Voisin, Roe.)

(4) Use a frame which can by the store of energy in springs, or a lifted weight, act as a catapult. (Wright Brothers.)

In each case the starting device (carriage, sledge, or catapult) may be integral with, or separate from, the machine. Separately, weight is, of course, saved. On the other hand, the machine is useless without the hoisting device. Starting-stages with necessary catapults or other devices have been suggested. The Aéro Club de France tests machines from a steel tower in the Galerie des Machines, on the principle given third in the foregoing list.

With regard to descent, this is intimately related to gliding stability. As we have seen, if the weight is in the right place, oscillations will be damped out, and the descending machine will follow a straight descending line with a uniform velocity. The alighting springs should be capable of storing the energy of impact corresponding to this speed and angle.

Helicoptères.

It will have become evident from what has been said that this type of machine is more or less at a discount. Machines have been made by Santos Dumont, Kress, Dufaux, and others, but as yet the results are not very important. The ability to soar is undoubtedly a great advantage, but the loss due to insufficient air supply, the absence of wedge action, and the necessity for further machinery to give lateral propulsion are great drawbacks. Mr. Rankine Kennedy is one of the strongest advocates of this type just now, and is evidently convinced as to its ultimate success. The author has interested himself in the type for a long time, but cannot say that at present he considers it to be superior to the aëroplane. In a paper just presented to the Aëronautical Society he has discussed the question.

Ornithoptères.

Profs. Marey and Pettigrew have shown that the wings of flying animals rotate while reciprocating, so as to provide a forward thrust as well as a downward one. (See "The Problem of Flight," p. 59.) The researches of Mouillard, Langley, Fitzgerald, and Deprez have also shown how the greater flying birds manage to utilise the pulsations of the wind and its vertical component to soar and glide. Lord Rayleigh has given simple rules in this connection.

A type not uncommon (on paper) is the rotating machine, in which a number of blades are controlled by a cam, so that on the downstroke they move perpendicular to their planes and on the upstroke parallel to their planes, and thus produce an upward resultant thrust. The mechanical efficiency of such an arrangement cannot be so high as that of an aëroplane. Moy's aërial steamer and centrifugal fan types correspond to this variety.

Future Work.

Reference has been made to the necessity for further research as to the centre of pressure. Information is also wanted as to the resistance and stability of combined planes, the thrust of screw propellers, and the effect of lateral currents on propellers and gliders. The mathematical analysis of the equations of motion of the aëroplane in space needs to be advanced. Simpler forms of the equations of stability and trajectory are required. The application of the latest investigations as to resistance (such as M. Eiffel's) and centre of pressure to these equations has yet to be made, and bird flight needs much study by ornithologists trained in applied mechanics.

Relation to War and Commerce.[1]

The sudden development of aërial navigation led to a popular panic which was quite baseless. At present the dirigible balloon is extremely vulnerable, cannot carry more than a few pounds' weight of projectiles, and has great difficulty in hitting a mark. In espionage it may be useful. Aëroplanes may perhaps be presently available for attacking vital points and despatch work, but it will be long before they will be steady in a wind.

Commercially, the outlook is worse. Although the energy required for aërial transport is not much greater than in terrestrial and marine locomotion, the danger and unpunctuality will take many years to eliminate. Wind occasionally (not frequently) will have serious effects on direction and time of passage. Eventually the airship and flying machine will affect society, but the author thinks it will not be for some years to come.

Finally, the author wishes to point out the deplorable backwardness of English invention in this direction.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following programme for the Darwin centenary celebrations, subject to alteration in detail, will be issued at an early date:—

Tuesday, June 22.—8.30 p.m. to 11 p.m., reception of delegates and other invited guests by the Chancellor in the Fitzwilliam Museum. By kind permission of the master and fellows, the gardens of Peterhouse will be accessible from the museum.

Wednesday, June 23.—10.30 a.m., presentation of addresses by delegates in the Senate house; 2.30 p.m. to 3.45 p.m., visits to colleges; 4 p.m., garden-party given by the master and fellows of Christ's College in the college grounds; 7 p.m., banquet in the new examination hall; 10 p.m. to 12 p.m., the Vice-Chancellor and fellows of Pembroke College "At Home" in the college hall and gardens.

Thursday, June 24.—11 a.m., honorary degrees conferred in the Senate house; 12 a.m., Rede lecture in the Senate house by Sir Archibald Geikie, president of the Royal Society.

A Darwin exhibition will be held in Christ's College on the lines of the Milton exhibition of last year. The syndics of the University Press have agreed to present to each invited guest a copy of the first draft of "The Origin of Species," which is being prepared for press and edited by Mr. Francis Darwin. This is the draft of which Mr. Darwin speaks in his autobiography:—"In June, 1843, I first allowed myself the satisfaction of writing a very brief abstract of my theory in pencil in thirty-five pages."

It is proposed to prepare an illustrated programme of the commemoration containing some account of Darwin's Cambridge days, under the editorship of the registrary, the senior secretary to the celebration committee.

Of the seventeen colleges, fifteen have now published the results of their entrance scholarship examinations. The number of scholarships has slightly increased, and in natural sciences seven and a half more scholarships have been awarded this year than last. The mathematical scholarships are fewer by the same number; the half represents a scholarship which has been awarded partly for natural sciences and partly for some other subject. There is also an increase of four in the history scholarships. Out of the 201 scholarships, 74 have been awarded for classics, $43\frac{1}{2}$ for natural sciences, and $35\frac{1}{2}$ for mathematics. Only eight candidates availed themselves of their privilege of resigning their emoluments whilst retaining the status of a scholar.

The special board for biology and geology has appointed Mr. J. Stanley Gardiner, of Gonville and Caius College, to be a manager of the Balfour fund until June 14, 1911, in succession to Dr. Harmer, who has resigned.

Mr. David Sharp has resigned the curatorship in zoology from March 25, 1909, and Mr. Hugh Scott, of Trinity College, has been appointed in his stead for one year from March 25, 1909.

[1] See article by Prof. Newcomb in the *Nineteenth Century*, September 1908.

The Gordon Wigan income for 1908 at the disposal of the special board for biology and geology has been applied as follows:—(*a*) 50*l*. to Mr. D. Sharp, the curator in zoology; (*b*) 50*l*. to Mr. A. G. Tansley, to enable the botanic garden syndicate to continue to offer special facilities for plant-breeding experiments; and (*c*) 50*l*. to Prof. Hughes, being 30*l*. for the purchase of a projection lantern for the geological department, and 20*l*. for the expenses of research on Pleistocene deposits in the neighbourhood. The prize of 50*l*. from the Gordon Wigan fund for an investigation in chemistry was awarded in the year 1908 to Mr. L. A. Levy, of Clare College, for his essay entitled "Investigations on the Fluorescence of Platinocyanides."

At the last meeting of the committee of Bristol University, the treasurer, Mr. George A. Wills, mentioned that he had received from Lord Winterstoke a letter intimating that he was prepared to give an additional 15,000*l*. towards the University. This, with the 20,000*l*. he had already given, makes Lord Winterstoke's contribution to the fund 35,000*l*.

A very interesting article on foreign associates of national societies, by Prof. E. C. Pickering, of Harvard College Observatory, which was published in the *Popular Science Monthly* in October last, has been received in excerpt form. Prof. Pickering points out that mere membership of scientific societies is, in general, a poor test of the qualifications of a man of science; but the case is very different if only foreign associates of the principal national societies or academies of the world are considered. Dealing with the physical and natural sciences alone, and assuming that foreign associates are elected wholly for eminence in a particular science, Prof. Pickering arrives at some important conclusions so far as the United States are concerned. Speaking of American representation among foreign members of the seven great scientific societies of the world, he says that in the United States the representation per million inhabitants is less than a fifth that of the principal countries of Europe. There is no American representative in mathematics or medicine, while in astronomy there are three out of ten members. Prof. Pickering explains this result by saying that while immense sums are spent on higher education in the United States, the endowment for advanced research is comparatively small. He states that astronomy is almost the only science having institutions in America devoted to research, and in which a great deal of the time and energy of men of science is not expended in teaching. Of the six American foreign associates referred to, five have occupied positions in which no teaching was required, but their entire time was supposed to be devoted to original investigation.

It has often been pointed out that the courses of instruction in schools in India have been hitherto far too literary in character, and that the whole training has not been sufficiently scientific and practical. Education in India has, in fact, suffered, as education in England suffered for a generation, because of the inability of the responsible authorities to understand that book-learning is not the knowledge that makes for progress. The supreme test of educational success is not the power to reproduce the words or works of others, but the ability to undertake an independent inquiry and to arrive at sound conclusions. The science teaching which is truly scientific makes the printed or spoken word subsidiary to the workshop or laboratory exercises, and uses adaptability rather than phonographic capacity as a measure of mental growth. As the only sound basis of scientific instruction is individual experience and activity, the extent of ground which can be studied by practical methods in a school course is necessarily limited. In our schools this is being recognised, and good science syllabuses only include subjects with which pupils may reasonably be expected to become acquainted by experiment. In several provinces of India such a desirable state of responsible opinion does not seem yet to have been reached. For instance, the *United Provinces Government Gazette*, published at Allahabad at the end of last year, contains a science syllabus for the award of high-school scholarships, and we have no hesitation in saying that it would be better not to teach science at all than to attempt to cover the extensive course prescribed for the candidates. In addition to the rudimentary principles of physics and chemistry—which by themselves are more than sufficient for a school course studied by scientific methods—the syllabus includes subjects from sound, light, heat, electricity and magnetism, and chemistry of metals and non-metals. The syllabus in elementary science (physics and chemistry) for the matriculation examination of the University of Madras is of similar character—extensive instead of intensive. To prescribe such syllabuses for Indian students is to put a premium upon learning by reading rather than by doing. It may be urged that practical work is impossible in many Indian schools; but that provides no justification for instituting science courses which require a large equipment of apparatus when taught properly, instead of courses which can be studied experimentally with few special appliances. Directors of public instruction in India who desire to know how the experimental method of science can be successfully introduced into village schools should inquire into the work of the Irish Board of National Education, which has excellent schemes of work capable of being carried out without special equipment and at a minimum cost.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, January 12.—Prof. J. Rose Bradford, F.R.S., vice-president, in the chair.—Observations on the flagellates parasitic in the blood of fresh-water fishes: Prof. E. A. **Minchin.** Five species of Trypanosoma and four species (two new) of Trypanoplasma, from fishes of the Norfolk Broads, were described in detail. Particular attention was paid to the minute structure of the parasites, and it was shown that it is possible to give a uniform description for the nuclear apparatus of both Trypanosoma and Trypanoplasma.—Zoological results of the third Tanganyika expedition, 1904–5. Report on the Copepoda: Prof. G. O. **Sars.**—The gonadial grooves of a medusa, *Aurelia aurita*: T. **Goodey.** The author dealt with investigations which confirmed his earlier suggestion that the gonadial grooves, which lie in the interradial axes between the central gastric cavity and the gastric pouches, have a sexual function. From sectionised material, drawings had been obtained of spermatozoa and eggs lying within the limits of the gonadial grooves, thus proving that the latter are functional gonoducts.—The tuberculin test in monkeys, with notes on the temperature of mammals: Dr. A. E. **Brown.** The paper described the methods and results of experiments which have recently been carried out at the zoological gardens of Philadelphia with the view of suppressing tuberculosis in monkeys.—*Balaena glacialis* and its capture in recent years in the North Atlantic by Norwegian whalers: Prof. R. **Collett.**

Geological Society, January 13.—Prof. W. J. Sollas, F.R.S., president, in the chair.—Labradorite-norite with porphyritic labradorite: Prof. J. H. L. **Vogt.** This rock occurs off the northern coast of Norway. It contains 23 per cent. of labradorite-phenocrysts, in a crystalline groundmass of a more acid plagioclase, hypersthene, diallage, and titanomagnetite. Olivine is conspicuously absent. The plagioclase-phenocrysts are more acid in their outer zones, and the groundmass plagioclase is still more acid. From analyses the relative proportions of the constituents are calculated, and the formula of the felspars determined. The order of crystallisation is found to be:—(1) phenocryst plagioclase; (2) plagioclase with magnetite; and (3) plagioclase, magnetite, pyroxenes. The order of crystallisation follows the physicochemical laws applying to the phase liquid-solid. Graphic representations illustrate the order of crystallisation of a ternary system of plagioclase, magnetite, and pyroxene. Equilibrium between the solid and the liquid albite-anorthite phase must have been maintained long enough for the phenocrysts to acquire a composition different from the first crystals, but eventually the equilibrium broke down. The temperature-interval of crystallisation is estimated to have been between about 1400° and 1000°. This investigation suggests that the processes of crystallisation in a magma may be explained in all details according to physicochemical laws.—The genus

Loxonema, with descriptions of new proterozoic species: Mrs. Jane **Longstaff** (*née* Donald). There is some confusion with regard to the type of the genus Loxonema. The author, following Lindström, Koken, and Perner, takes *L. sinuosum*, Sowerby, as the type. Then the other two types mentioned by Phillips cannot remain in the genus, one belonging to the genus Macrocheilina and the other to Zygopleura. The paper deals only with Ordovician and Silurian species. The diagnosis of Loxonema is amended, and a note given as to the range and the distribution of the genus.

Linnean Society, January 21.—Dr. D. H. Scott, F.R.S., president, in the chair.—The genus Nototriche, Turcz.: A. W. **Hill**. The genus Nototriche (Malvaceæ) includes some seventy species formerly placed in the genus Malvastrum, A. Gray. Two types of flower are found in the genus; in the one case the petals are almost free, and are fused with the staminal column only at the base; in the other, including the majority of the species, there is a definite tube formed by the fusion of the petals with the staminal tube. At the base of each calyx segment there is a glandular nectary. The carpels are beaked and dehiscent, and are often provided with long, silky stellate hairs. In the paper several new species are defined, and the descriptions of those already known have been amplified and re-written. Longitudinal symmetry of Centrospermæ: Dr. Percy **Groom**. By means of measurements of many stems primary, secondary, tertiary, and quaternary—of one species, *Atriplex rosea*, and of other chenopodiaceous genera, namely, Salsola and Chenopodium, additional evidence is given that the internode curve of alternate-leaved Chenopodiaceæ is always of a zigzag nature, and can be analysed into two subcurves. Of these, one represents the displacements of the leaves from the originally opposite arrangement at the successive nodes, and the other indicates the lengths of the modern representatives of the original internodes.

Institution of Mining and Metallurgy, January 21.—Mr. Alfred James, president, in the chair.—A theory of volcanic action and ore deposits, their nature and cause: Hiram W. **Hixon**. Starting with the known fact that there is an increase of temperature of about 1° C. for each 100 feet of depth, the author claims that at about 100 miles below the surface of the earth the temperature is above the critical temperature of all known elements, from which it is assumed that all matter from the commencement of the zone of critical temperature to the centre of the earth is in a gaseous condition. The conclusion arrived at is that within that zone a part of each of the gases present is diffused throughout the zone. Secular cooling results in reducing the outer surface of the zone below the critical temperature of a part of some of the gases. As a result of secular cooling matter of high critical temperature is added to the "zone of flowage" of the solid crust, while the gases of low critical temperature would saturate the zone of flowage and segregate upward to the bottom of the "zone of fracture." There the further upward progress of the gases would be stopped until, by accumulation, they had acquired sufficient elastic force to rupture the zone of fracture. From this—the author's theory of volcanic action—is deduced his theory of ore deposition.—The Silver Islet vein, Lake Superior: Walter **McDermott**. This paper was presented, though a reprint from a technical journal published thirty-two years previously, as it bore on the subject of the foregoing paper on volcanic action and ore deposits, chiefly in connection with the occurrence of graphite and silver. It dealt with facts, however, rather than with theories.—An instance of secondary impoverishment: H. H. **Knox**. This paper, dealing with deposits on the private estates of Kishtim, in the government of Perm, Russia, had to be held over for discussion at the February meeting.

PARIS.

Academy of Sciences, January 25.—M. Bouchard in the chair.—Presentation of vols. xi. and xiii. of the *Annales de l'Observatoire de Nice*: M. **Bassot**. The first volume contains four memoirs:—the velocity of light by the toothed-wheel method, meridian observations, equatorial and meridian observations concerning the planet Eros, and the third catalogue of nebulæ discovered with the large Nice equatorial by M. Javelle. The other volume is devoted to meteorology. Reunion of the permanent international committee of the map of the sky: B. **Baillaud**. This committee will meet at the Paris Observatory from April 19–24.—A *résumé* of some observations of M. A. Ricco on the earthquake in Sicily and Calabria of December 28, 1908: A. **Lacroix**. A map is given showing the epicentral zone at Messina, and seven other zones, classified according to the severity of the effects produced.—A fossil alga from the Sinemurian: P. **Fliche**. This fossil was shown to arise from a purely cellular plant, and this conclusion was derived, not only from the characters of the parenchyma constituting the plant, but also from the elliptic bodies borne on its surface. This is the first plant of its kind found in the Lias.—The tenth campaign of the *Princesse Alice II.*: **Albert I., Prince of Monaco**.—Fridtjof Nansen addressed a letter to the perpetual secretary concerning the proposed Polar expedition of Captain R. Amundsen.—The deformation of surfaces of negative curvature: E. **Goursat**.—Electrocapillary phenomena in gases at low pressures: G. **Reboul**. A capillary electrometer in which the dilute acid is replaced by a rarefied gas exhibits analogous phenomena.—An arrangement for sensibly reinforcing the sound perceived in a receiver with an electrolytic detector: M. **Jégou**.—A plate with a network of lines giving stereoscopic relief by direct vision: E. **Estanave**.—A new method of preparation of the alkyl ethers: J. B. **Senderens**. The catalytic substance employed is alumina, obtained by precipitating sodium aluminate with sulphuric acid. If this is maintained at a temperature between 240° C. and 260° C., and the vapour of ethyl alcohol passed over it, ethyl ether is continuously formed. It is not necessary for the success of this experiment that the alcohol should be absolute. Methyl ether and propyl ether have been obtained in the same way.—The condensation of the mesoxalic esters with tertiary aromatic amines: A. **Guyot** and E. **Michel**.—The regeneration of coffee plantations by the introduction of a new species: Jean **Dybowski**. Owing to the destruction of *Coffea arabica* by disease, many districts have been obliged to grow coffee. The substitution of *Coffea liberica*, a more robust plant, has not been successful, owing to the inferior quality of the coffee produced by this plant. The author now proposes the use of a new species, *Coffea congoensis*, which grows wild in the neighbourhood of Oubanghi. Its resistance to the disease of Hemileia appears to be well established; the coffee berries are of good commercial quality, and it contains about 1·2 per cent. of caffeine.—The unification of the number of segments in the larvæ of the Muscidæ: J. **Pantel**.—Contribution to the study of the constitution of the proteid materials by the hydrolysing action of hydrofluoric acid. The preparation of definite natural peptides: L. **Hugonenq** and A. **Morel**. The advantages of the use of a 25 per cent. solution of hydrofluoric acid as a hydrolysing agent have been pointed out in a previous paper. It is now shown that by varying the strength of the acid employed the hydrolysis can be stopped at different stages, and several well-defined natural peptides have been isolated in this way (as the picrate).—The ammoniacal fermentation: J. **Effront**.—The value of the muscular striations in polarised light: Fred. **Vlès**.—The application of d'Arsonvalisation localised to certain regions, principally in the cephalic region: A. **Moutier**. In these experiments the solenoid only surrounded the head and shoulders. In all the cases treated the results were favourable; the objective phenomena disappeared, and the arterial pressure was lowered.—The extension of the rhætic sheet in the pre-Alps of Berne and Fribourg: F. **Rabowski**.—The rhætic sheet in the Vaudois pre-Alps: Alphonse **Jeannet**.—Transportation phenomena in Anjou and Brittany: E. **Jourdy**.—The value of the magnetic elements at the Observatory of Val-Joyeux on January 1, 1909: M. **Moureaux**.—The earthquake of January 23, 1909: Alfred **Angot**. A copy of the seismographic trace from the Parc Saint-Maur Observatory is given.

NEW SOUTH WALES.

Royal Society, December 2, 1908.—Mr. W. M. Hamlet, president, in the chair.—Diagram showing the rainfall of Australia: J. **Barling**. The chart is designed

to show, at a glance, the annual rainfall of many years for all Australia, as taken from the official returns. Geraldton, Queensland, holds the record for great rains, while the least rainfall of Australia appears to be that of Lake Eyre and its vicinity. The lake, now, is mostly a dry bed, and is below sea-level. A second chart shows the daily rainfall of Sydney for the past fifty years, together with other details.—Revision of the Australian Orectolobidæ: J. D. **Ogilby** and A. R. **McCulloch.** An account of the Australian members of the family, which includes the wobbegongs or carpet sharks, cat sharks, &c. Diagnoses of the genera and species are given, and a new name, Cirrhorhinus, is proposed for *Brachaelurus colcloughi*, Ogilby. The extraordinary egg-case of *Chiloscyllium punctatum*, M. and H., is described for the first time. Whereas in most other sharks the egg-case is attached to surrounding weeds, &c., by long tendriliform processes at either end, that of *C. punctatum* hangs by a median loop, the parts of which are woven round the support by the lips of the parent after deposition. The paper is illustrated with plates of several of the species.—Some geological notes on the country behind Jervis Bay: Dr. H. I. **Jensen.** The writer shows that the country between the Upper Shoalhaven and the sea has the character of a raised marine plain subsequently dissected by faulting and erosion. The Sassafras Tableland and Currockbilly Range he considers to be a "horst" or "block mountain."—Vocabulary of the Ngarrugu tribe, New South Wales: R. H. **Mathews.**—The sedimentary rocks of the Lower Shoalhaven River: C. F. **Laseron.** In this paper it is intended primarily to show the geological sequence of the various formations in the district and the local geographical changes which took place at the close of the period, during which the Clyde Coal-measures were deposited.—The discontinuity of potential at the surface of glowing carbon: J. A. **Pollock,** A. B. B. **Ranclaud,** and E. P. **Norman.** In a circuit with one heated electrode in air at ordinary pressure, the projection of ions from the hot surface necessitates the establishment of a potential difference between the electrodes if the current in the circuit is to be zero. This potential difference in certain circumstances may be taken as a measure of the surface discontinuity, and values have been obtained in the case of glowing carbon at various temperatures.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 4.

ROYAL SOCIETY, at 4.30.—On the Electricity of Rain and its Origin in Thunderstorms: Dr. George C. Simpson.—The Effect of Pressure upon Arc Spectra, No. 3, Silver. λ 4000–λ 4600: W. Geoffrey Duffield—. The Tension of Metallic Films deposited by Electrolysis: G. Gerald Stoney.—A Further Note on the Conversion of Diamond into Coke in High Vacuum by Cathode Rays: A. A. Campbell Swinton.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—The Stability of Arches: Prof. Henry Adams.

LINNEAN SOCIETY, at 8.—On *Fucus spiralis*, Linn.: Dr. F. Börgesen.—Economy of *Ichneumon manifestator*, Linn.: C. Morley.—On the Polyzoa of Madeira: Rev Canon Norman, F.R.S.

RÖNTGEN SOCIETY, at 8.15.—The Transport of Ions: Dr. Howard Pirie.

FRIDAY, FEBRUARY 5.

ROYAL INSTITUTION, at 9.—The Influence of Superstition on the Growth of Institutions: Prof. J. G. Frazer.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design and Construction of Docks: Sir Whately Eliot.

GEOLOGISTS' ASSOCIATION, at 7.30.—Annual General Meeting.—Presidential Address: The Jubilee of the Geologists' Association: Prof. W. W. Watts, F.R.S.

MONDAY, FEBRUARY 8.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—My Recent Expedition in Tibet: Dr. Sven Hedin.

TUESDAY, FEBRUARY 9.

ROYAL INSTITUTION, at 3.—The Architectural and Sculptural Antiquities of India: Prof A. A. Macdonell.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Deneholes: Rev. J. W. Hayes.

FARADAY SOCIETY, at 8.—Applications of Electrolytic Chlorine to Sewage Purification and Deodorisation by the "Oxychlorides" Process: Dr. S. Rideal.—A New Electrical Hardening Furnace: E. Sabersky.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: On Heat-flow and Temperature-distribution in the Gas-engine: Prof. B. Hopkinson.

COLD STORAGE AND ICE ASSOCIATION (Royal Society of Arts), at 7.30.—Some Scientific Problems in the Preservation of Food by Artificial Refrigeration: C. T. Tabor.

WEDNESDAY, FEBRUARY 10.

GEOLOGICAL SOCIETY, at 8.—Geological Features observable at the Carpalla China-Clay Pit, Cornwall: J. H. Collins.—Recent Observations on the Brighton Cliff-formation: E. A. Martin.

ROYAL SOCIETY OF ARTS, at 8.—Bosnia and Herzegovina: A. R Colquhoun.

THURSDAY, FEBRUARY 11.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Nerves of the Atrio-ventricular Bundle: J. Gordon Wilson.—An Experimental Estimation of the Theory of Ancestral Contributions in Heredity: A. D. Darbishire.—On the Determination of a Coefficient by which the Rate of Diffusion of Stain and other Substances into Living Cells can be measured, and by which Bacteria and other Cells may be Differentiated: H. C. Ross.—The Origin and Destiny of Cholesterol in the Animal Organism. Part III., The Absorption of Cholesterol from the Food and its Appearance in the Blood: C. Dorée and J. A. Gardner.—On the Origin and Destiny of Cholesterol in the Animal Organism. Part IV., The Cholesterol Contents of Eggs and Chicks: G. W. Ellis and J. A. Gardner.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Use of Large Gas Engines for Generating Power: L. Andrews and R. Porter.

MATHEMATICAL SOCIETY, at 5.30.—On the Relation between Pfaff's Problem and the Calculus of Variations: Prof. A. C. Dixon.—On Implicit Functions and their Differentials: Dr. W. H. Young.—On a Certain Family of Cubic Surfaces: W. H. Salmon.—Some Fundamental Properties of Lebesgue Integrals in a Two-dimensional Domain: Dr. E. W. Hobson.—Modular Invariants of a General System of Linear Forms: Prof. L. E. Dickson.

CONTENTS.

THURSDAY, FEBRUARY 11, 1909.

A NEW ENCYCLOPÆDIA OF AGRICULTURE.

Encyclopaedia of Agriculture by the Most Eminent Authorities. 3 vols. Edited by C. E. Green and D. Young. Vol. i., pp. xii+582. Vol. ii., pp. vii+536. Vol. iii., pp. viii+633. (Edinburgh and London: W. Green and Sons, n.d.) Price 20s. net per volume.

THE increasing interest taken in agricultural matters is in no way better shown than by the number of books that have recently been issued. Apart from a host of text-books, at least three large and expensive works of reference have been published within quite a short period. It is a good thing that the demand for such works exists; certainly the present-day farmer stands in need of all the assistance he can get. "There never was a time," say the editors very truly in their preface, "when accurate systematised knowledge regarding the best agricultural methods was more urgently required than now." The increased cost of labour, and the rising charges on land, make it absolutely essential that the farmer should adopt every labour-saving device, and every scheme for reducing the cost of production and for getting the maximum return from his land or his beasts. The object of the volumes before us is "to serve a great use in the way of spreading an accurate knowledge of agricultural science and of the best methods of agricultural practice."

A careful perusal of a number of the articles shows that the work is intended for those taking a general interest in the subject, rather than for the student who is specialising or the expert. The articles are usually too short to allow of much detail, and in some cases the writers have aimed chiefly at showing the bearing of the subject in hand on ordinary farm practice. As a rule, the articles are written in a style that will appeal to the practical man, and they are eminently calculated to arouse his interest in the subject; in some instances a list of standard works is given from which fuller information can be obtained.

The practical matters are in the hands of such capable men as Messrs. Primrose McConnell, John Speir, John Wrightson, W. J. Malden, and others, and are clear, concise, and to the point, giving good accounts of the best practice; we need only mention the articles on ploughs, drainage, forage crops, and potatoes. Live stock receives due attention, and in addition to the ordinary descriptions, we are given admirable reproductions of photographs of good beasts; indeed, these illustrations are quite a feature of the work. The principles of breeding are ably dealt with by Prof. Cossar Ewart, and the bearing of Galton's and Mendel's laws on breeding practice is indicated. There are probably no more skilful stock breeders in the whole world than those of the British Isles, but their success has hitherto been more the result of inborn genius than of education; indeed, the stock breeder will commonly assert that science is of no use for his work. Prof. Ewart shows the fallacy of this position, and gives some illustrations of the value of Mendel's laws in practice. It has long been recognised, he states, that blue Andalusian fowls never breed true. However carefully bred, only about half the offspring are blue, while the other half are pure black or white with black splashes. Yet when the blacks and white splashed are crossed, they yield blue Andalusians. These facts, at one time thought so contradictory, are, of course, in strict accordance with law, and indicate the hybrid nature of the blue Andalusian.

Direct practical application of Mendel's law is suggested in rejuvenating strains showing signs of deterioration. It has hitherto been customary to bring in new blood from a closely related breed, so that the first crosses resemble the parents, *e.g.* in rejuvenating the Chartley herd a Welsh race was used, and the crosses were very like the old Chartleys. A certain number of the Chartleys were also crossed with white Highland cattle, and the first crosses did not resemble Chartleys, so that this method was not regarded favourably by the practical man. However, by mating Highland-Chartley bulls with Highland-Chartley heifers it may be confidently anticipated that a certain proportion of the offspring will resemble the Chartleys but have some of the Highland stamina. Prof. Ewart also goes fully into telegony, and into the persistent hypothesis of "maternal impressions," and shows that no experimental evidence can be adduced in favour of either.

The botanical subjects are dealt with by Prof. Percival, and, needless to say, his treatment is admirable. Insect pests are described by Dr. MacDougall.

On looking down the list of contributors we notice some very curious omissions; it includes no bacteriologist, no chemist except the dairy chemist, and no geologist. The articles on these subjects have been written by practical agriculturists. The experiment was a bold one to make, and has not turned out a success; it has resulted in several poor articles and in a host of errors which greatly mar the value of the work. The general article on bacteriology, for instance, is obviously the work of an amateur who has "got up" the subject from a text-book; there is a good deal of talking round the subject, but we never get anywhere; the reader feels unsatisfied, and if this were a fair presentment of the subject, would be disposed to agree with the statement that "the subject of soil bacteria is not likely to enlist the attention of practical men." The bacteriology of the manure heap has been altogether too much for our author, and after a vain struggle with "aerobic and anaerobic, nitrous, nitric and ammoniacal bacteria, desulphuricans and ferricans," he gives up the unequal contest. We are told that bacteria "multiply with extraordinary rapidity, and occupy the entire bulk of the invaded material in a few hours, or even minutes."

There is an equal lack of treatment about the chemical articles, but the text-book used is older; sulphuric and phosphoric acids are said to "contain

the elements of water, until they combine with a base which supplants the basic water" (vol. i., p. 26). A large number of mistakes are made. "In the process of digestion the carbohydrates are converted by the saliva into cane sugar (maltose, $C_{12}H_{22}O_{11}$) and further into dextrose and levulose," both of which are regarded as varieties of glucose (vol. ii., p. 268). Fish oil is said to be a hydrocarbon. There is a considerable amount of confusion. Dyer's solvent in soil analysis is variously stated to be 1 per cent. nitric acid, 1 per cent. ammonium citrate solution (which is in one place said to be a weak acid and in another an alkali), and 1 per cent. citric acid. The bacterial reduction of nitrates taking place in absence of air, and the evolution of nitrogen from organic matter decomposing in presence of air, get hopelessly confused in the article on denitrification. In describing calcium cyanamide, "the form of lime-nitrogen in which the nitrogen is derived from the air," no distinction whatever is drawn between this substance and the Notodden calcium nitrate; the writer evidently regards them as one and the same thing. Contradictions are not infrequent; under nitrate of soda it is stated that "soda never has been found to be of appreciable manurial value," yet the same writer sixty pages back was insisting on the advantage of manuring mangolds with salt! The author has not much faith in his own chemistry; he impresses on us that there are "forces of vitality which in many cases modify the action of chemical laws and even render them abortive."

It would be easy to multiply instances. The result is all the more regrettable since it conveys an impression of general carelessness and inaccuracy which would not be justified. These unfortunate mistakes make the book an unsafe guide for the student, and prevent it from taking a high place in agricultural literature. It cannot, however, be urged that they are likely to mislead the farmer in his practice. Even with all their errors these articles make interesting reading, and are calculated to show the farmer, if he still needs showing, that there is something in the application of science to practice, and thus to clear the way for the county council lecturer or the agricultural college.

E. J. RUSSELL.

THE CAMPAIGN AGAINST TUBERCULOSIS.

The Prevention of Tuberculosis. By Dr. Arthur Newsholme. Pp. ix+429. (London: Methuen and Co., n.d.) Price 10s. 6d. net.

THE native races of the tropics have their various plagues and pestilences; tuberculosis is generally regarded as the white man's scourge. The incidence of tuberculous diseases among the inhabitants of the British Isles is indeed a heavy one, as shown by the statistical data contained in the opening chapter of the book under review, but it may not be so generally known that tuberculosis has been introduced by the colonising white man among many native races, among whom in some instances it is assuming alarming proportions. On these grounds, therefore, there is ample justification for the publication of this work, which deals first with the causes, and then with the prevention, of this disease.

The first paragraph of the book strikes the key-note of the subsequent matter:—

"Tuberculosis is a disease caused by the destructive lesions set up in the lungs or in other parts of the body by a special bacillus or microbe. The disease is infectious, *i.e.* is communicable from man to man and from animals to man; and it never originates in the body apart from the invasion of the special bacillus."

Tuberculosis, therefore, being placed among the infective diseases, it is natural to compare the death-rate due to it with that of the chief infective diseases—measles, whooping-cough, diarrhœa, enteric, scarlet and typhus fevers, small-pox and diphtheria. We learn that in 1904 the number of deaths in England and Wales from all these were 67,154; from tuberculous diseases there were 60,205, or, in other words, tuberculous diseases in 1904 caused sixty deaths for every sixty-seven caused by the aggregate of the chief acute infectious diseases!

In chapter ii. the magnitude of the evil is discussed from the economic point of view. Thus, taking the statistics of the phthisis (consumption) admissions to the Brighton workhouse infirmary from July 15, 1897, to May 23, 1905, Dr. Newsholme calculates that the cost to the rate-payers amounted to more than 1000*l.* per annum, and on this basis the indoor relief expended on the treatment of consumptives in the workhouse infirmaries of England and Wales amounts to 331,000*l.* per annum. A brief but sufficient sketch of the history, morbid anatomy, and symptoms of phthisis and an account of the tubercle bacillus follows, and then in chapters vii.–ix. the important question of the infectivity of tuberculosis is discussed. Of this the author has no doubt, and the portals and channels of infection are considered in succeeding chapters. It is satisfactory to find that tuberculosis is declining, and in part ii. the causes of the reduction in mortality from phthisis from 281 per 100,000 living in 1850–4 to 123 in 1901–4 are surveyed. The argument and conclusion are that *institutional segregation* is the predominant cause of the decline of phthisis in this country.

Finally, in part iii. the measures for the reduction and annihilation of tuberculosis are discussed. The author favours the view that the diminution of infection outweighs in importance the diminution of the conditions favouring infection, and therefore the early recognition of the disease together with notification are of importance, for then institutional segregation and sanatorium treatment may be secured at that early stage so essential if a cure is to be hoped for, so necessary for the prevention of infection. The various preventive methods are discussed in some detail, and the administrator will gather many valuable hints from a perusal of this portion of the book.

Although, as stated in the preface, written almost entirely from the standpoint of the public health administrator, and intended primarily for medical officers of health, the book is free from technicalities,

and may be commended to the notice of a much wider public, viz. all those interested in the national question of the prevention of tuberculosis and in the public health. The book is light to hold, is printed in pleasant type, and is illustrated with numerous statistical charts and some figures. R. T. H.

TRADITION AND MONUMENTAL REMAINS.

Folk Memory, or the Continuity of British Archaeology. By Walter Johnson. Pp. 416. (Oxford: Clarendon Press, 1908.) Price 12*s.* 6*d.* net.

MR. JOHNSON puts before the student of tradition a study which, whether or not it be accepted in all its details, will be recognised as a valuable addition to our knowledge of the archæological remains of our country. It tells us both of the means by which these remains have often been preserved and of the machinery by which a great mass of tradition has been handed down during the ages. A monument is protected by a custom, superstition or tradition attached to it, while the much frailer life of the custom, superstition or tradition is preserved by the continued existence of the monument. It is obvious that we have here a most fruitful and hitherto largely neglected source of information. Even where tradition has obviously gone wrong, the point where it has gone wrong and the reasons and influence which have caused this deflection are laid bare by Mr. Johnson in many cases, and become a not unimportant part of his inquiry. We frankly confess that, despite objections here and there to conclusions wrongly drawn or drawn from authorities not of the first order, we are impressed by the cumulative value of the evidence which Mr. Johnson adduces. He is sound on most of the scientific problems he deals with, and does not allow his theory to master him.

Mr. Johnson is not always just to his own theory. Thus he directs attention to the important fact that in the Isle of Man it was believed that to pasture sheep on ground which was marked by a stone circle would surely bring disease to the flock, and he goes on to observe that "we call these ideas survivals, and thus hide their true character; in their totality they indicate, not spasmodic survivals, but continuity of development." The introduction of the qualification "spasmodic" is here wholly unwarranted. Survival is not spasmodic, but continuous, and Mr. Johnson not only spoils his own argument, but suggests that he does not understand the true significance of Mr. Tylor's admirable term. Again, he is not always correct in his evidence. His reference to the so-called Boadicea's tomb at Hampstead is to Mr. Read's admirable excavation of it and the suggestion, quite tentative, of its being a tomb of the Bronze age; but further research has been made into this subject, and it is now almost certain that this so-called tomb is a boundary mark of the Roman period, a *botontinus*, in fact, and the legend attaching it to Boadicea is explainable on this origin. We give these examples of faulty research or faulty argument, not for the purpose of discounting Mr. Johnson's work, but merely to show that even after the exhaustive inquiry he has made and the care with which he has marshalled the great mass of facts he has to deal with, there is still much to be done; and the much to be done confirms Mr. Johnson's general conclusions. In these two cases correction would mean additional evidence entirely of the kind that Mr. Johnson advances throughout his work.

The book is usefully, though not elaborately, illustrated, contains full and complete references to authorities, and has a good index. Its scope will be gathered by the following summary of its contents:—the continuity of the ages of Stone and Bronze, racial continuity, links between the prehistoric and protohistoric ages, traces of the ages of Stone and Bronze shown by later implements, stone and bronze in ceremonies and superstitions, the later history of the megaliths, fairies, mound-treasure and barrow superstitions, the reputed virtues of iron, our oldest industry (stone implements), dene holes, linchets, dew ponds, incised figures of our chalk downs, old roads and trackways.

VACCINATION AND OPSONIC ACTION.

Vaccine Therapy and the Opsonic Method of Treatment. By Dr. R. W. Allen. Second edition. Pp xii+244. (London: H. K. Lewis, 1908.) Price 7*s.* 6*d.* net.

THIS book will be found exceedingly useful at the present time, when vaccine therapy has become so popular and in certain fields has achieved such brilliant results. According to the author, the best results are, as a rule, obtained only when vaccination is carried out under the guidance of the opsonic index, but a critical study of his evidence in support of this belief will rather lead one to conclude that good results have been got in spite of the opsonic index and in spite of negative phases. The use of the expression "opsonic method of treatment," forming part of the title of the book, must be strongly deprecated. It is unscientific, and can appeal only to the undiscriminating reader who is unaware of the multiplicity of antibodies elaborated in response to vaccination.

The author commences with a summary review of current opinion on the nature of opsonic action. He believes that the weight of present evidence goes to show that opsonic action, like hæmolytic action, is due to the cooperation of thermostable amboceptor with a thermolabile complement. The practical difficulties in opsonic technique which must yet be overcome in order to do justice to this conception have not, however, been touched upon, nor has the author taken count of this conception in the interpretation of many of the opsonic results tabulated throughout the book. Regarding the site of formation of opsonin, the author concludes from his own experiments that this resides in the muscle tissues. He adduces in support of this view that the opsonic index of muscle plasma from an amputated leg was 1·4 towards various micro-organisms. Further, he mentions that a case of tubercular ulceration which had previously resisted treatment did well when the tuberculin was "injected in a concentric manner round the area of ulceration." We are not told whether the tuberculin was injected intra-

muscularly, but even if it had been, it would not necessarily have supported his claim.

Chapters ii. and iii. deal with the principles involved in vaccine therapy and with the determination of the opsonic index. The author is so strong a believer in the utility of the opsonic index in diagnosis, prognosis, and as a guide in vaccination that a critical review of the subject could not be expected of him, and we do not get it.

The chapters on the methods of obtaining pure cultures of infecting micro-organisms and on the preparation of their corresponding vaccines are well executed. Some micro-organisms, however, like the bacillus of Friedländer and the *Bacillus septus*, receive more attention and consideration than is consistent with our present knowledge as to the *rôle* played by them in disease.

Naturally a large amount of space is devoted to infections caused by the tubercle bacillus. As a result of his own experience the author recommends a mixture of human and bovine tuberculins. The dosage apparently differs enormously according to the guides followed. These may be clinical symptoms, the opsonic index, or common sense. Such multiplication of immunisation systems can only lead to confusion.

The remaining chapters deal with the application of vaccine therapy to many other forms of infection, and the results that have hitherto been achieved.

SCIENCE OUT OF SCHOOL.

Chambers's Wonder Books. (1) *The Wonder Book of Volcanoes and Earthquakes.* By Prof. E. J. Houston. Pp. x+369. (2) *The Wonder Book of the Atmosphere.* By the same author. Pp. ix+326. (3) *Electricity for Young People.* By Tudor Jenks. Pp. viii+317. (4) *Photography for Young People.* By the same author. Pp. x+328. (New York: Frederick A. Stokes Co.; London and Edinburgh: W. and R. Chambers, Ltd., 1908.) Price 3s. 6d. each.

THE proper function of books of the type under review is to awaken interest in the boys to whom they are addressed. This may be accomplished by appealing to the boy's love of adventure or of animals; or the appeal may be to the constructional instinct, in which case the book should bring science into direct relation with the boy's interests and environment, suggesting to him possibilities of experiment upon his own account. On a higher intellectual level we have to deal with the lad who has reached a more mature stage of mental development and has risen to the height of strictly scientific interests. He now desires *rerum cognoscere causas*, and seeks knowledge in order to obtain intellectual control of natural forces. A valuable stage in his culture will be achieved if at this epoch we can give him an historical survey of the growth of scientific discovery. In such popular histories it is difficult to avoid excess of biography in the earlier portions, and excess of technicality as the present day is approached. Books dealing with boys' hobbies are numerous, and (we are glad to add) often enjoy success. Of the higher type of book—specimens of well-written, untechnical scientific literature—there is an undoubted lack to-day.

The books with which we have now to deal are diverse in character and quality, although appearing in the same series. Even in a short criticism it will be advisable to direct attention to the characteristics of books which are likely to fulfil the function of mental stimulants.

(1) Prof. Houston describes a number of volcanic eruptions and earthquakes. His theme is catastrophe, and he succeeds in producing an impressive compilation of historic disasters due to explosive eruptions or to earthquakes of the first magnitude. He is very precise in stating dates, and the heights—to the nearest foot—of volcanic summits. Our author may be given credit for picturesque descriptions, but it must be regretted that he adopts the cataclysmic geology of Dana. He even puts forward the abandoned theories of "geological revolutions"—with their concomitant exterminations of life—as though such views were generally held by geologists of the present day! We may regard the omission of this or that "important branch of the subject" as no real demerit; but we must condemn writings likely to implant fundamentally wrong ideas, which will provide much for youthful readers to unlearn.

(2) The subject of the second book in the series affords admirable opportunities for suggesting experiments such as would exercise the constructive instinct of his readers. Unfortunately, the opportunity is utilised to an extent which is practically negligible. A very wide range of topics is introduced, and the chapter on the Weather Bureau of the United States may be commended. Many anecdotes are introduced, but they do not suggest, nor would the book as a whole suggest, any steady advance of human knowledge. Exception may fairly be taken to many details, and the style is not calculated to promote accurate thinking. The author's account of Archimedes is regrettable. On such important matters as adiabatic expansion and the rise of clouds he betrays an inability to grip the essentials of the phenomena he sets out to explain.

(3) Mr. Tudor Jenks tells the story of mankind's acquisition of control over electricity, and in so doing gives us a book full of information—probably too full. The first hundred pages contain a considerable amount of biographical matter relating to discoveries from Lucretius to Morse. In books intended for boys it is wise to introduce biography; but this should be done by selecting a few pioneers of science, telling the story of their struggles and achievements with just so much detail as will give a vivid and realistic picture of the men and their surroundings. To do this requires the touch of the artist in words; it is not to be accomplished by relating long strings of events. Still less is it wise to try to tell the story of scientific discovery by snippets of information about a multitude of minor contributors to its progress. Mr. Jenks has been a painstaking student of the history of electricity, and has acquired extensive knowledge; our complaint is that he has compressed too much of this knowledge into a book intended for young people. In the latter half of the work he shows remarkable skill in con-

densing the manifold discoveries of recent years into small compass without sacrifice of accuracy. But he would have produced a more readable, and, we think, more effective book, had he ruthlessly cut out half his information, and expanded the other half so as to supply a series of more carefully graded explanations. A youth who has already made a hobby of electrical-instrument making or who has studied the subject successfully at school might read "Electricity for Young People" with interest, and in that case he would certainly read it with profit.

(4) In the fourth volume of the series, Mr. Jenks had an easier task, since "Photography for Young People" appeals directly to a favourite pursuit. There is a good chance of success for any book of moderate price which tells a boy with sufficient clearness the methods by which he can succeed in his hobby. In this book the young photographer will find good practical instructions, and a particularly clear exposition of the principles of the art he is striving to master. The author is at home alike when dealing with the beginnings of photography and when putting the latest discoveries within reach of the young amateur. Technical terms are properly treated, *i.e.* they are not evaded, but used after explanations have been given in simple language. The acquisition of such terms is enjoyed by a boy, and is good for him provided they are made to become part of his mental possessions—tools in his mental workshop. In each of these volumes a very fair standard is reached as regards illustrations, print, and binding. A plea may be urged for yet more copious illustrations in such books, as the youthful reader is greatly helped thereby. Both (3) and (4) are well indexed.

G. F. D.

PHYSICAL ACOUSTICS.

(1) *A Text-book of Sound.* By Prof. E. H. Barton. Pp. xvi+687; illustrations. (London: Macmillan and Co., Ltd., 1908.) Price 10*s.* net.

(2) *Traité de Physique.* By O. D. Chwolson. Translated by E. Davaux. Tome i., fascicule iv. Acoustique. Pp. vii+873–1092. (Paris: A. Hermann, 1908.) Price 8 francs.

(1) PROBABLY no branch of physics is so poorly represented by text-books as that of sound. Between very elementary volumes and Lord Rayleigh's masterly treatise very little exists. The former are too trivial, while the latter is far too severe for the first or second year senior undergraduate. For this reason, amongst others, the present volume will be received gladly by both teacher and student, for it very adequately fills the gap in our expositional literature.

What, then, are the main characteristics of this book which confer superiority upon it? In the first place, the author does not hesitate to employ the elements of the calculus, although in many cases geometrical proofs are given as well. We think the day is now gone in which it was supposed that a student's undergraduate work could be carried on without reference to the calculus. We know that university regulations have in some cases encouraged this belief; but teachers have for a long time ignored these restrictions and have freely employed the calculus in their demonstrations. We hope that the time may come when mathematicians will see their way to give an adequate introduction to such methods in the first collegiate year. It is possible that some matters which are dear to them will need to be postponed until later in order that this may be done. The attempt is made, and satisfactorily so, in some schools; we hope that this practice will become universal. It is true that in some cases an exceedingly quick and convincing proof of a theorem can be obtained by geometrical methods; but, on the other hand, the present writer could lay his finger on pages of proof, partly algebraic, partly graphical, which could all be condensed into a few lines, and which have caused endless bother to the students with whom he has come in contact. Even in the book before us the graphical parts are not those which are clearest, though we have nothing but praise for the thorough way in which those parts are dealt with.

The second main characteristic is the close connection, maintained throughout, between theory and experiment. A treatise on sound is bound to be somewhat mathematical; but the author never misses a chance of introducing an experimental illustration or an account of some experimental verification of a theorem proved.

After a short preliminary survey the book continues with a somewhat long mathematical account of the kinematical and dynamical bases of the subject (including a chapter on elasticity). It is, perhaps, in this part that a curtailment might have been made. The elastic properties of bodies are now usually considered under the head of properties of matter. (By the way, is not the method for calculating the velocity of sound in a gas which starts by superposing an equal but opposite velocity due to Rankine? The author seems to imply that it is Rayleigh's method.) We regret that the part devoted both to the theoretical and experimental side of diffraction should be so short. Dr. Barton probably considers that this should be left to be treated in a text-book on light.

In the third place, we commend this book because it rings true to the spirit of research. The author has himself contributed in some degree to our knowledge of the subject, and he is abreast of the most recent work that has been done in connection with it. This is very notably the case in the large section which deals with musical instruments. Dr. Barton is specially qualified to deal with this side of the subject. The result is that we find here a compendium on the physical side of the qualities of musical instruments such as we believe cannot be found elsewhere.

Of recent work considered, mention may be made of Lord Rayleigh's work on the perception of sound direction, recent considerations in connection with the pressure of radiation, modern work on combination tones (no mention is made, however, of Barrett and Bolas's work on this subject), and the work of Sabine and of Marage on architectural acoustics. The last item is one in connection with which very little is definitely known, and to which research might very well be directed.

Dr. Barton has copied Lord Rayleigh in concluding with a section on electrical oscillations. We have never quite understood why this subject should be treated so fully in a text-book on sound. Some knowledge is, of course, needed in connection with the electrical maintenance of vibrations; but the knowledge so required is very much more than supplied by the theorems given here.

There are twenty-three pages of questions at the end. There are very few misprints in the entire book. We notice *modulus* spelt wrongly twice on p. 131, and we believe that it is to W. König, not A. König, that the explanation of the striated appearance of the dust in a Kundt's tube should be attributed.

(2) The second book which heads this review is a French translation of a Russian text-book. The German translation of the same portion was reviewed by us some time ago, and consequently a very brief notice will now suffice. To the present translation there is a preface by Amagat, and to the eulogistic remarks which he makes on Chwolson's treatise we would add that we consider the entire text-book to be the most satisfactory and complete of any with which we have met. The present part is, perhaps, not the most striking in its superiority; that praise must be reserved for the volume on heat and thermodynamics; but the critical judgment which Chwolson everywhere exhibits has enabled him to deal with the subject of sound in a very masterly way.

OUR BOOK SHELF.

The Zonal-belt Hypothesis. A New Explanation of the Cause of the Ice Ages. By Joseph T. Wheeler. Pp. 402. (Philadelphia and London: J. B. Lippincott Co., 1908.) Price 2.50 dollars net.

THE author of this book has read widely, and the latter two-thirds of it, dealing with comparative mythology, may be useful on account of the quotations. The first third is, as Mr. Wheeler shows in his historical introduction, a development of an idea suggested by Tyndall and by several later authors, to the effect that a thin "canopy" of a gas, capable of transmitting the luminous heat of the sun, but impervious to the dark heat-rays radiated back from the earth, might have a profound effect on the general climate. Such canopies may have arisen from time to time through the fall of rings of matter external to the atmosphere.

The author prefers to regard these rings as planetesimal in origin, and the new point introduced by him is the possibility that the canopies were resolved into belts, thus permitting of strong climatic zones. It is presumed that each ring, as it approached the earth, would divide and spread away as canopies towards both poles, where the centrifugal force was least. Such a time would be a generally warm one, with the production of clouds from evaporated water. These clouds would occur in high levels of the atmosphere, and would assist the rise of temperature. As the canopy aged and became unstable at its edges, it moved back towards the equator, leaving "natural sun-controlled climatic conditions," *i.e.* colder ones, in its wake (p. 103). The regions under the canopy would remain cloudy and warm. Condensation now took place in "the middle ground between the pole and the canopy belt." Here we have all that is needed for the production of a glacial period. Fluctuations in the position of the edges of the canopy would account for interglacial episodes. The final breaking up of the planetesimal belt, and the disappearance of the accompanying atmospheric cloud-belt, caused the glaciation to invade the whole earth (p. 114). Primitive man saw the latest cloud-belts, which originated the myths of serpents twined about the earth.

The gases or planetesimal materials of each original belt are held to have been ultimately deposited as cosmic dust over the globe, after the manner of Mr. H. L. Fairchild's primitive "cosmoclastics" (p. 44). "As a canopy fell a geological age ended, and with it its life conditions" (p. 52). A large number of facts are called in to support the hypothesis, and even the size of Carboniferous insects is said to be an indication of a denser atmosphere. When it is suggested (p. 45) that the earth that has accumulated round the ruins of Nippur "may be in part the wind-blown remnants of cosmical world chaff," we feel inclined to appeal to geology rather than speculation; and it is with this feeling that we lay down the volume. One of the best things in the unfolding of Mr. Wheeler's hypothesis is the prominence given to the idea that tropical heat is quite compatible with an atmosphere of cloudy darkness.

G. A. J. C.

A Monograph of the British Desmidiaceae. By W. West and Dr. G. S. West. Vol. iii. Pp. xv+274; 31 plates (lxv.–xcv., of which 14 coloured). Sixty-fifth year of issue. (London: Printed for the Ray Society, 1908.) Price 25s. net.

IN notices of the earlier volumes we have had occasion to speak very highly of this work, which deservedly takes a front rank among monographs devoted to a single family of plants. The merits so conspicuous in these volumes are equally so in this, which is devoted entirely to a part of the great genus Cosmarium. Beginning with species 51, the text closes with species 224; but seven additional species are figured, although exigencies of space require their descriptions to be held over to vol. iv. A very large number of the species have named forms or varieties under them. A considerable proportion of these, and a few of the species, are new to science. The references to the literature under each already known species and variety are very ample. In discussing the distribution of each, the authors are careful to acknowledge the work of others, the names of Roy and Bissett occurring very frequently, and Archer, Cooke, Ralf, and Wills on many pages; but the larger part of the whole is the result of the very extensive researches among fresh-water algæ carried out by the authors themselves in many parts of the British Islands. The distribution beyond our islands is also given, and for some species is extraordinarily wide, *e.g.* *C. venustum* extends over the northern hemisphere, and has also been found in Java, Australia, and Paraguay, and several others are also dispersed in the fresh waters of almost every part of the world where desmids have been sought for. Under most of the species important notes direct attention to the more distinctive characters, the relations to allied forms, whether British or from other countries, peculiarities of habitat, and other characteristics that cannot be introduced into a systematic description, but which are often exceedingly helpful.

Every species and almost every variety and "form" are figured in the plates, wherever possible in positions to show the forms and markings or sculpture from the different aspects required to give a true conception of these characters. The details of the cell-wall are always shown in uncoloured, and usually the appearance of the living cells in coloured figures, all alike being the work of Dr. G. S. West.

An inspection of the plates and reference to the text show how valuable an aid they afford to the student in the recognition of the species.

The continuation of the work will be looked for with desire and hope by all interested in this beautiful family of microscopic algæ.

Crops, their Characteristics and their Cultivation. By Primrose McConnell. Pp. xii+115. (London: Cassell and Co., Ltd., 1908.) Price 1*s.* net.

THE author of this little book is one of the few present-day farmers who are also writers, and he has given us an admirable account of the crops commonly cultivated, which cannot fail to be valuable both to the agricultural student and the practical man. The first two chapters are devoted to the general conditions necessary for plant growth, and to those conditions which, though not essential, are favourable, and therefore complied with in practice. Then follow descriptions of the various crops arranged under their agricultural headings, viz. cereals, pulses, forage crops, root crops, and grasses. The last two chapters deal respectively with the manuring of crops and with their common pests.

The book is well up to date in practical matters. The author notes the growing tendency to depart from strict rule in the matter of rotations, and to grow whatever pays best at the moment, provided always there is a change of crop. He also observes that improved methods of cultivation and the use of labour-saving machinery have made it possible to grow wheat at prices impossible thirty years ago, and he anticipates a revival of wheat cultivation in England. Most of those who have studied the problem will agree with the author here.

On the scientific side the author tends to take a rather more definite position than the evidence justifies, *e.g.* in his account of nitrification, of the acid excreted by roots, and of the reason why certain crops require certain manures rather than others; but otherwise the book is very free from errors, and can be cordially recommended to all interested in the subject.

The Moths of the British Isles. By Richard South. Second Series, comprising the Families Noctuidæ to Hepialidæ; with accurately coloured figures of every Species, and many Varieties; also drawings of Eggs, Caterpillars, Chrysalids, and Food-plants. Pp. vi+376; 159 plates, 20 text-figures. (London and New York: Frederick Warne and Co., 1908.) Price 7*s.* 6*d.* net.

THE present volume concludes Mr. South's excellent synopsis of the British Macro-lepidoptera, which occupies three volumes, one of butterflies and one of moths having appeared previously. We have already spoken favourably of the earlier volumes, and it is now our pleasing duty to say that there is no falling-off in the execution of the text and plates of the volume before us. Little attempt is made to describe the perfect insects; and indeed a good figure is in many cases sufficient for the identification of many insects; but the range of variation is usually indicated, and caterpillars, habits and localities are usually recorded in detail. As before, we have usually coloured figures of moths on one side of a plate, and plain ones of caterpillars and chrysalids on the other; but sometimes, as in plate 146, which represents Zygænidæ, we have coloured figures of moths on both sides. The figures are usually excellent, but in the case of the emeralds they are unsatisfactory, the figures coming out rather under-coloured, which we suppose is due to some deficiency in the colour-printing. The letterpress is very good and up-to-date, but we do not notice on pp. 55 and 56 any reference to the two specimens of *Thalpochares parva* taken by Dr. Battersby at Torquay in 1859.

In conclusion, we may say that English names for butterflies and moths, which were always reprobated by Stainton, have been coming into general use lately, and most of the popular books now issued give them equal prominence with the Latin names. W. F. K.

Les Stations lacustres d'Europe aux Ages de la Pierre et du Bronze. By Dr. Robert Munro. French edition by Dr. Paul Rodet. Pp. 295. (Paris: Schleicher Frères, 1908.) Price 12 francs.

THIS is an excellent translation into French of the classical work of Dr. Munro on "The Lake Dwellings of Europe," reviewed in NATURE, February 12, 1891. The French edition is not so extensive as the original work. It deals only with lake dwellings of the Stone age and of the Bronze age, the chapters relating to lake dwellings of the Iron age, to the *terramara* of North Italy, to the *terpen* of Holland, and to the *crannogs* of the British Isles being omitted. Several valuable additions have, however, been made to the French edition which make it a very complete, up-to-date compendium of the Stone and Bronze age lake dwellings of Europe. Among these additions we note a map of the lake dwellings surrounding the Alps prepared by M. Adrien de Mortillet, and a map of the lake dwellings of Lake Bienne discriminating between those of the Stone, Copper, Bronze, and Iron age.

Paragraphs are added by the translator giving a description of discoveries that have been made since the date of publication of the original work in 1890. It is to be regretted that the translator has not brought up to date Perrin's statistics of bronze objects from Lake Bourget.

An interesting table is given of the analysis of bronzes from the lake dwellings, and we note that many of them contain small percentages of lead, nickle, cobalt, iron, silver, antimony, and zinc. These foreign substances may be of some value in helping to trace the provenance of the ores used by these prehistoric peoples for their metallurgical operations.

Les Progrès récents de l'Astronomie. By Prof. P. Stroobant. Pp. 98; illustrated. (Brussels: M. Hayez, 112 rue de Louvain, 1908.)

ALL who are interested in the progress of astronomical knowledge should welcome Prof. Stroobant's most useful summary, now issued separately as an extract from "L'Annuaire astronomique de l'Observatoire royal de Belgique."

This small volume is nearly three times the size of its predecessor, and contains a *résumé* of practically all the important astronomical discoveries and advances made during the year 1907. In the first section we get an account of the solar work, including notes on the re-determinations of the sun's rotation period and parallax; then follows a summary of the observations of the transit of Mercury, which is illustrated by a pair of photographs arranged for the stereoscope, a duplicate, detachable plate being included to obviate the necessity of defacing the book.

The observations of the planets, of comets, of variable and double stars, &c., are also discussed, and the book concludes with various notes on such subjects as stellar distances, nebulæ, refraction, and the variation of latitude. The section dealing with comets is illustrated by two excellent photographs of Daniel's comet, taken by Prof. Wolf at Heidelberg.

W. E. ROLSTON.

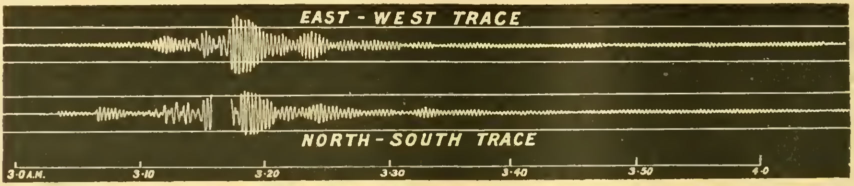
LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Seismograms of the Earthquake of January 23.

WITH reference to the article on "Recent Earthquakes" in NATURE of January 28, the accompanying records of the earthquake of January 23 may perhaps be of interest. These are from negatives printed from the original curves taken with the Milne twin-boom seismograph at the new magnetic observatory at Eskdalemuir, Dumfries-shire, of which Mr. G. W. Walker is superintendent.

The interval between the breaks in the curve (not shown in the accompanying reproduction) is one hour, and the hour mark near the commencement of the earthquake corresponds, as nearly as could be ascertained, to 3h. 5m. a.m., G.M.T., January 23. The natural period of both booms is 18·6s., and the sensitivity is such that 1 mm. = 0″·44.



The east-west is clearer than the north-south trace, and a short piece of the latter is omitted, as it is not possible to reproduce it with certainty from the negative.

R. T. GLAZEBROOK.

The National Physical Laboratory, Teddington, Middlesex, February 1.

The Italian Earthquake.

THE able article in NATURE of January 7 (p. 277) by "R. D. O.," and the useful notes appended thereto, have no doubt been read with interest by students of physical geology all the world over. I should like to add a few remarks, which may perhaps be also found useful.

Thanks to the masterly teaching of the veteran geologist Prof. Suess, of Vienna, as first outlined in his smaller work, "Die Entstehung der Alpen," and to the teaching of the Swiss school, we have learned in the last two decades to trace a clearer causal connection between disturbances of this sort and the local architectonic structure of the lithosphere. The essential factor of such phenomena would seem to be the local weakness of the crust, resulting in its yielding, in this area or in that, to variations of stress in those potentially molten portions of the lithosphere, which, while practically rigid under the rapid rotatory motion of the earth (see my letter to NATURE, May 4, 1905, on "The Rigidity of the Earth's Interior"), exist under planetary pressure at temperatures above the solid-liquid critical temperature of the mineral masses of which they are composed.

The variations referred to (whether from cosmic or terrestrial causes) compel portions of the overlying crust, of course, to adjust themselves under the influence of gravitation to the altered mechanical conditions. Such adjustments may, and generally do, occur on lines of ancient "faulting," and may be classified as positive and negative. The former we should expect to occur as downward movements under the direct action of gravitation where faulting occurs in a synclinal flexure, the tendency of the bed-rock being to sag down, and in such cases we get a slip-fault movement. On the other hand, where any part of the force of gravity is resolved into tangential thrusts on or near axes of anticlinal flexures, the fault-movements are almost bound to be of an overthrust nature. Of these two types we may regard the San Francisco earthquake of 1906 as an instance of a slip-fault movement. The later Valparaiso earthquake, on the other hand, would appear to have been due to movement on planes of overthrust faulting in an anticline, and this alone would account for the greater and more widespread devastation witnessed in that case.

Applying this reasoning to the earthquake of December 28 last, we should expect to find that the movement was of the Valparaiso type, and this receives confirmation from the external fissuring of the ground at the surface. A reference to Prestwich's geological map of Europe throws light at once upon the problem. The Messina Strait is seen to be on the axis of an anticlinal flexure, the sea being there less than 100 fathoms deep. The 100-fathom contour is seen to approach the strait at both ends, and then to double rather sharply back, especially on the Ionian side, while the 1000-fathom contour runs in approximate parallelism to it, and much nearer to it on the Ionian side than on the Tyrrhenian side. The faulting, which Prof. Suess is reported to have sketched in the Vienna papers, seems to cut through the Archæan crystalline mass in the north of Calabria, and then to follow its western boundary for some distance further south, coinciding in part with the shore-line. Under the strait itself it seems to bifurcate "in the direction of Etna," according to Suess, but I would suggest along the southern limit of the exposed crystalline mass, which forms the high promontory of the Peloritan mountains, since Taormina appears to have escaped the effects of the earthquake. The point of bifurcation would be the weakest place, and therefore the locality in which the upthrust would be most perceptible. If this is admitted, we may discern here the true cause of the dual wave which swamped the low-lying portions of both Messina and Reggio.

Further, the steepness of the submarine gradients on the south or Ionian side of the area, as compared with those on the Tyrrhenian side, seems to indicate the existence, on a much smaller scale, of conditions which hold good in Japan, where the bed of the ocean rapidly descends to the greatest oceanic depth known on the Pacific side, the "concave" side of the "mountain-wave" (Suess), as compared with the gradients of the "convex side," the shallow Sea of Japan. Prof. Suess (one of our greatest masters) will therefore perhaps allow me to suggest that the seismic movement in the present instance occurred rather on or just outside the rim of the disc-like area of subsidence which is occupied by the Tyrrhenian Sea, an area of which the Lipari Islands with their volcanoes mark an incidental fracture-feature (as worked out years ago by Judd) rather than the centre.

In the view here put forward the minor earthquake shocks felt a fortnight or so later in the Tuscan region, at Ravenna, and other places, would follow as incidents in the more complete adjustment of the geologically young range of the Apennines to the disturbances of previous mechanical equilibrium, caused by the greater disturbance on the other side of the Tyrrhenian Sea, which has startled the world by its results. The differential results in the Messina-Reggio region would seem, further, to be accounted for by sidelong movements of the ground due to overthrust faulting, so terrible always in its effect upon buildings badly constructed and erected upon such loose and incoherent rock-materials as those which constitute the Quaternary and later Tertiary strata, upon which the low-

lying portions of the ill-fated cities and the Calabrian villages once stood. It is a warning to those who may be in any way responsible for rebuilding them.

A. IRVING.

Bishop's Stortford, January 21.

The Isothermal Layer of the Atmosphere.

MR. DINES makes a happy choice of terms when he writes of the isothermal *column* (NATURE, January 21, p. 341). Each of the unrejected traces is interpreted to show a more or less isothermal column, and it is by mentally piecing together these columns into a sort of honeycomb that the miscalled isothermal *layer* is brought into existence. It must not be forgotten that this hypothetical layer has a very uneven floor, and that each cell in the honeycomb has its own particular temperature. This is a complex structure. I certainly think it more feasible to ascribe the sudden and sustained minimum in the temperature curve, which is the gist of this discussion, to some idiosyncrasy or limit to which all the instruments, foreign as well as native, are subject night and day, and on the down as well as the up journey. In your issue of January 21 I referred to the falling density of the air current, upon which current the whole experiment depends. If the trace shows a uniform temperature during the upper 9 kilometres of an ascent, there is no escape from the conclusion that the temperature of the air has steadily fallen to compensate for its tenuity, and if we assume an adequate compression of the hydrogen before the rubber gives way, there is a further compensation required for loss of speed.

I shall now endeavour to answer Mr. Dines's points by the help of the old-fashioned laws of heat.

"The isothermal column of air shows just as plainly in ascents made after sunset as in those made in the day."

Yes. Radiation is stronger by day, but radiation and convection balance at some point, and the balance, if maintained, means a regular fall of temperature upwards.

"At night the thermograph must receive some heat by radiation from the earth, and lose some by radiation into space, but both amounts must be infinitesimal in comparison with that which would be given to it by the sun."

Being quite close to the hot planet, and being far below the temperature due to such proximity, the balloon, &c., will receive more radiation than they emit. The radiation from the planet, subtending nearly a hemisphere, will be far from infinitesimal compared with that of the sun.

"That solar radiation in the ordinary conditions is not important is proved by the fact that if the balloon bursts, and therefore does not float, it is not possible to say from the trace alone if the ascent was by night or by day."

If solar radiation cannot be detected on the traces it must be because they differ so much *inter se.* Surely if aëration is so good for the thermograph it must be equally good for the balloon, and a perfect torrent of warmed air must waft on to the instrument during the ascent.

"There have been cases in which the balloon did not burst, and the temperature at the top reached the freezing point of water."

This shows an approach to what I call the natural temperature of a body between the sun and a warm planet. Of course, the balloon, instrument, &c., would have been much hotter out of contact with the cold air which was basking in the sunshine at a temperature of about 100° F. *below* freezing. This recalls the question with which I finished my last letter.

"I still believe that radiation at night to and from the bright metal of the thermograph is so trifling that the rate of ascent is of no consequence."

The whole apparatus is admirably contrived—let us try faithfully to decipher the trace it gives us. The thermograph is scores of degrees below its natural temperature. This argues an intake of heat by absorption of rays, which heat is taken by the air current. The current must be colder or more rapid at the 20-kilometre level to give the traces that are now under discussion.

"There is also the fact that the up-trace, where the motion is comparatively slow, is identical with the down-trace where the motion is rapid."

Mr. Dines has dispensed with a timepiece in many cases. Can he speak positively as to the vertical speeds? If it is quite clear that the down-speed is greater I can only suggest that with a parachute the motion is partly lateral, *i.e.* a gliding motion *through the air*, which would tend to interfere with the draught, as would also the parachute acting as a cover to the screen. Perhaps also the parachute subtends a larger angle than the balloon did.

Summarising the matter, I contend that "isothermal layer" is a misleading misnomer.

The basaltic structure of the upper air which is inferred from the traces is intrinsically improbable.

To get the temperature of the air from the trace a curve must be drawn on its low-temperature side and diverging upwards.

The result will be a non-isothermal curve.

The amount of this correction for all currents can be determined on the instrument in the laboratory.

R. F. HUGHES.

The Size of the Leather Turtle.

As trustworthy weights and measurements of large turtles are not often available, the following measurements and weight of a leather-back turtle, Sphargis, are submitted in the hope of eliciting further data regarding this or other species. The total length of the animal, measured along the curve from the nose to tail, was 6 feet 10 inches; the carapace along the curve, 5 feet 2 inches; the circumference at the widest part of the carapace, 7 feet 2 inches; from tip to tip of front flippers, over the shoulders, 8 feet 9 inches. Weight, a little more than 840 lb., for, when on the scales, the tips of the large front flippers rested on the ground. This is one of the largest turtles of this species that has come under my observation. Another specimen that I was able to weigh turned the scales at 740 lb.

F. A. LUCAS.

Museum of the Brooklyn Institute, Eastern Parkway, Brooklyn, N.Y.

Moral Superiority among Birds.

IN NATURE of January 7 Mr. F. C. Constable describes an observation of the moral superiority of the blue-tit over the robin. This is by no means exceptional. I constantly observe the same thing from my dining-room window, where I have a string stretched across with pieces of cocoa-nut and pork-fat attached to it for the tits to feed upon. In the cold weather the robins come too, but they are never allowed to feed in company with the blue-tits; they are attacked at once if they venture to hold their ground. The long-tailed tits and the cole-tits are much less aggressive, and will even give way to the robins.

LAURA D. H. DUKES.

23 Torrs Park, Ilfracombe, February 1.

WOMEN AND THE FELLOWSHIP OF THE CHEMICAL SOCIETY.

IN our issue of July 9, 1908 (vol. lxxviii., p. 226), we directed attention to the fact that an influentially signed memorial had been presented to the council of the Chemical Society stating that, in the opinion of the memorialists, 312 in number, including ten past presidents, twelve vice-presidents, and twenty-nine members of council, among whom were thirty-three Fellows of the Royal Society, and the heads of the chemical departments of nearly all the most important universities and colleges in the kingdom, the time had come when duly qualified women should be admitted to the fellowship of the society, and praying that the council would take the necessary steps to permit of their election.

The council, having taken the memorial into consideration, determined to consult the whole body of the society, and instructed a committee to prepare a statement of reasons for and against the proposal, to be submitted, together with the memorial itself, to

each fellow, with a view to elicit a definite statement of his opinion as to the expediency of acquiescing in the prayer of the memorial.

We had occasion at the time to animadvert on the manner in which certain members of the council, and in particular the executive officers of the society, allowed their declared hostility to the admission of women to the fellowship to get the better of their judgment and sense of fair play, and we commented on the significance of the protest on the part of a large majority of the past presidents, which was sent to every fellow of the society—a protest which lost nothing of its force by the studied moderation of its expression of indignation.

The result of this referendum was that, by a large majority—1094 for and 642 against—the fellows expressed their opinion that the desire of the memorialists should be acceded to, and that duly qualified women should be admitted to the full rights and privileges of fellowship.

After having put the society to the expense and trouble of a referendum on an issue which was definitely stated with all the reasons for and against which could be urged, it might have been assumed that the council, as a representative body and in its fiduciary capacity, would have given heed to the expression of opinion which it had deliberately invited. Certain members of the council were, however, determined that nothing of the kind should be done. No matter what the size of the majority in favour of the admission of women might be, a contumacious and recalcitrant element in the minority—a cabal of London chemists, in fact, in no proper sense representative of the general feeling of the society—set themselves to thwart the wishes of the majority of the fellows. The whole business of the referendum was thereupon deliberately reduced to a fiasco. It was expedient, however, to temporise. The size and character of the majority was too significant and weighty for it to be treated with too great an appearance of contempt, and accordingly it was decided to offer such women as the council should think fit the privilege of attending the society's meetings, of consulting the society's library, and of purchasing the society's publications at cost price, but to deny them the fellowship.

This, of course, was not carrying out the mandate which the council had received. It was, indeed, in flagrant and contumacious opposition to it. It was necessary, therefore, to make some show of justification for such a course, and the result was one of the most remarkable productions in the way of excuse, evasion, partial statement and special pleading which a perverted and not over-scrupulous ingenuity could put together. This *apologia* is published in No. 349 of the society's Proceedings, and will serve to make that issue historical. By way of preamble it recites, with a chastened sobriety, the results of the voting, and then proceeds to state what was perfectly well known to the council before they instituted the referendum, and should have been stated to the fellows on that occasion by those who raised objections to the admission of women, that, having regard to the state of the law affecting women at the time of the granting of the Charter, there might be legal difficulties in its interpretation, and that these difficulties—if they really existed—might not be overcome unless practically the whole of the society was unanimous in praying for a supplementary or amended Charter. It does not state, however, what is the fact, that, whatever may be the difficulty as regards married women, counsel advised that, in the event of the society deciding to admit women, it should make the necessary alteration in its bye-laws. This advice clearly shows that, in the opinion of counsel, the society might certainly admit unmarried women to the fellowship without serious risk to its action being legally challenged, if it were minded to do so, at the trifling cost of amending its bye-laws.

The fact is, there is not a single word in the Charter which either explicitly or implicitly excludes women. It has been held, indeed, by legal authority that by the very wording of the Charter it was clearly contemplated that women might possibly become fellows. Nor is there anything in the nature, functions, or objects of the society as defined by its founders which would preclude the admission of women. These facts were brought to the knowledge of the council on the authority of an eminent lawyer, whose written opinion was laid before them. But no hint of a possible conflict of legal opinion is given in the *apologia* which was put forward on behalf of the council, and only that particular one is referred to, and only so much of it is quoted as serves the purpose of him who drafted the argument. The net result of this conflict of legal opinion on the mind of the council was that it was a case of *tot homines, tot sententiae*.

It is obvious that the whole of the *apologia* put forward on behalf of the council is simply a disingenuous plea of *non possumus*.

Every fair-minded person is now convinced that if the society is determined to admit duly qualified women to its fellowship it can do so without troubling itself about its Charter, and with no risk of an injunction against it so long as such women fulfil the objects of the society and are prepared to comply with its laws. In fact, what it has already done in regard to the election of Madame Curie as an honorary member it can do in regard to any British-born woman as an ordinary fellow.

But now comes the Nemesis. The council having professed their great anxiety concerning the legal difficulties they have conjured up, and which, like so many lions in the path, they say confront them, proceed to disregard the Charter and propose to act in a wholly irregular and unconstitutional way. They enact a resolution, indistinguishable, as has been said, in form and substance from a bye-law, and create a special class called "Subscribers," in no sense differing from that of the associates mentioned in the Charter, except that it is restricted to women, who are not admitted by the ballot of the fellows as are the associates. The difficulty of the council is obvious. Although the women so admitted are, in effect, associates, to call them so would be to give away the whole case. Hence the institution of the new grade. This makes confusion worse confounded. Whilst professing to have regard to the Charter, the council deliberately ignores or sets aside its provisions. No such resolution can take effect until it is sanctioned as a bye-law by a general meeting.

The fact is the council, under the direction of unwise advisers, have bungled in this business from start to finish. The only prudent step they have taken was to elicit the general feeling of the fellows. Having obtained it, they should have acted loyally and in good faith, and have sought to give effect to it. As it is, they have been led by devious and crooked ways from the straight path, with the customary result. The position now is as irregular as it is inequitable, and as illogical as it is unjust. Their plain duty is to retrace their steps and end an unseemly episode by doing what common sense, reason and justice demand.

In the meantime, the women concerned have, with a wiser instinct than that which has actuated the council, declined to accept the invitation to take up a position which, in view of its irregularity, would

have made themselves and the council ridiculous, and would have prejudiced their case as regards the fellowship.

This issue—namely, the position of women chemists in regard to a society which professes to have no other aims than the promotion of chemistry—is one which is bound to be settled in favour of the women. Men have no prerogatives as regards the study and cultivation of natural knowledge. It is open to women, as human beings, to follow its pursuit if they are so minded, and they have the same moral rights as men to benefit by membership of an organisation which has been created to further its interests. We admit women to our colleges and universities; they work in our chemical laboratories; they engage themselves in the business of original chemical inquiry; we publish their scientific communications in our journals; and we confer upon them our degrees in science. Why, then, should the Chemical Society of London be singular in refusing to admit them as fellows? That it is singular is shown by the fact that even a purely professional society—the Institute of Chemistry—admits them. The Society of Chemical Industry places no obstacle in their way, and they are admitted to Continental and American chemical societies.

The small group of London chemists who have set themselves to oppose the wishes of the main body of the society have thereby raised an issue which is even broader than that which they have sought to evade. It is whether, in an essentially democratic institution like that of the Chemical Society, the will of the majority is to prevail, or whether it is to be thwarted by the machinations of a self-constituted oligarchy which abuses its trust and makes use of its opportunities to gratify its personal prejudices. Perhaps the general body of the fellows will have something to say on this matter at the forthcoming general meeting of the society.

PERIODICITY IN THE SUN AND THE RED VARIABLE STARS.[1]

THE mechanisms of the periodicities of the sun and stars are matters still of great obscurity. The cyclic change of the sun's spotted area has long been known, indeed can be traced in the early Chinese observations. In probable association with this are periodicities of facular and floccular areas, and of prominence activity. Coronal forms have been shown to change in type from point to point of this solar cycle, while recent observations of the so-called "solar constant" have shown its intrinsic variability. This last also is likely to be periodic. Such intimate first-hand knowledge is impossible in the case of the stars. Their integrated light changes alone can be examined. For variable stars about or below the solar level, according to the classifications of Secchi, Lockyer, or Pickering, some idea of the details of their variation may be obtained by analogy with the sun. In dealing with the red variable stars this method has been followed in the publication under review. This is an "Essai d'une Explication du Mécanisme de la Périodicité dans le Soleil et les Étoiles rouges variables," by A. Brester, Jz, Docteur ès Sciences, published by the Academy of Science, Amsterdam, 1908. The first accounts of the theory have been already reviewed in Nature (vol. xxxix., p. 492, and vol. xlvii., pp. 433, 434). Its main features remain unchanged. The present statement gives it in the light of more recent knowledge, amends it in detail, and extends its application, more especially, to the case of red variable stars.

[1] "Essai d'une Explication du Mécanisme de la Périodicité dans le Soleil et les Étoiles rouges variables." By A. Brester, Jz. Eerste Sectie. Deel ix., No. 6. Pp. 137. (Amsterdam: J. Muller, 1908.)

A short preliminary re-statement of the theory is perhaps desirable. In the case of the sun there is postulated a hot fluid globe made up of concentric layers of different substances arranged, more or less, according to their densities, and having angular velocities increasing with the depth in the sun. For the stability of such a stratification a relatively tranquil sun is demanded; such disturbances as are admitted are considered as being of the order of feebleness of terrestrial winds.

Radiation from the outermost solar layers provokes condensation, retarded by exothermic chemical action, which, falling as a torrential rain, forms the photospheric clouds. If the loss of heat above exceeds the gain of heat below the clouds increase in thickness and gradually reach lower and lower levels. In their descent they leave behind the finer condensed material, which serves to explain the loss of solar light at the limbs and the "yellow veil." The extreme brilliance of the photospheric clouds is likened to that of an incandescent mantle, the brightness of which seems to be associated with some subtle chemical activity. The breaks in the photosphere through which the re-vaporised clouds ascend constitute the spots, the vapours of which, though at least equal in temperature to the photospheric clouds, have smaller emissive powers. An upthrusting of faculæ would usually precede a spot, which seems to correspond to the latest observations, while the facular lag and equatorial acceleration of spots would follow from the assumed distribution of angular velocity.

The periodicity of the thickening and sinking of this photospheric cloud and its re-conversion into uprising vapour, which again condenses at a high level, grows in thickness and slowly reaches lower levels once more, is obviously too indefinite for mathematical treatment, so that the eleven-year cycle and the minor periodicities are still only facts of observation. An intensification of this clouding up of radiation and an increased periodic spottiness represent the extension of the theory to the red variable stars.

The tranquility and absence of eruptive phenomena, which the author regards as essential to his theory, are fearlessly imposed. Since the delicately poised strata must not be disturbed, the directly observed velocities, both on the photosphere, as spot and floccular changes, and at the limb, as prominence activities, are discredited as movements of matter. A transference of luminescence serves to explain them. The displacements of some solar lines indicate, on the principle of Döppler, velocities in the line of sight which the author holds as "impossible and absurd." Since line displacements are now known to be produced by other agencies, as well as by line-of-sight velocities, Döppler's principle is held to be untrustworthy. The invariability of the general Fraunhoferic spectrum is adduced as evidence of this photospheric calm, while the outermost different angular velocities of some of the solar layers, as indicated in the recent work of Prof. Hale, show, according to the author, that the "supposed solar eruptions cannot exist."

The above is a very brief sketch of the theory which in the essay is treated in great detail. A wealth of pertinent quotations and references is brought to its support, the collection of which must indeed have been a labour of love.

The parts which exothermic and endothermic chemical actions play in the theory are interesting. Dissociation, a distinctive solar theory of Sir Norman Lockyer, is used in this connection, though the relative temperature and the direction of motion in the umbræ of spots are the opposite of those given in

the sun-spot theory suggested by him. This latter theory recent solar work would seem to support.

While a transference of luminescence might be held as sufficient to account for the direct observations of apparently high velocities in prominences, it would not adequately account for the actual line displacements observed, which are so consistently dealt with by Doppler's principle. It is difficult to see why even a velocity of 300 miles per second in the outer regions of the solar atmosphere is held to be impossible. At the lower levels of the photosphere and reversing layer such enormous velocities are hardly to be expected, though even here the invariability of the spectrum is more apparent than real. Larger solar images and greater dispersion show local movements of the solar lines unobserved under less favourable conditions.

The independent rotation of some of the outermost solar layers is not vital to any theory, and indeed the outermost considered has the *highest* velocity apart from the lack of polar retardation. The existence of extensive magnetic fields in the sun due to the rotation of ions indicates velocities in excess of that which the author's theory would allow. The theory, however, seems a flexible one, and may provide even for these observations. The essay should be found both interesting and suggestive, though it can hardly carry conviction.

For his painstaking compilation of evidence, for his careful discussion of it, and for his daring unorthodoxy and consistency, the author deserves full credit. In the region of solar theory, during this age of subatomic physics, many of the grosser explanations and less subtle analogies, hitherto sufficient, may have to pass. The necessity for an alert and open mind is especially great.

THE INTERNATIONAL CONGRESS OF CHEMISTRY.

THE seventh International Congress of Chemistry will be held in London at the end of May. The congress meets every third year, the last meeting having been in Rome, and the one previous in Berlin. This is the first time that the congress, which is under the patronage of the King and the Prince of Wales, has been held in this country. Some two years ago an organising committee was formed of delegates from twenty societies which have interests in connection with chemistry, and also from the Chambers of Commerce of London and Manchester.

There are very few of the important industries which are not directly or indirectly indebted to technical chemistry for their development and success. Continental nations have long recognised this, and the congresses which have been held in the various cities of Europe have been well attended. It has been felt, also, that the holding of the congresses has materially contributed to the progress of the various countries by bringing the heads of the firms into personal contact with scientific men from all parts of the world.

The congress covers the whole domain of chemistry, and is divided up into eleven sections :—(1) analytical chemistry, (2) inorganic chemistry and allied industries, (3) metallurgy and mining, (4) organic products, (4*a*) colouring substances and their uses, (5) industry and chemistry of sugar, (6) starch industry, (6*a*) fermentation, (7) agricultural chemistry, (8) medical chemistry, (8*a*) pharmaceutical chemistry, (8*b*) bromatology, (9) photochemistry, (10) electrochemistry and physical chemistry, (11) law, political economics, and legislation with reference to chemical industries.

British delegates who have attended these congresses have always been well received and entertained in a most hospitable manner. It is hoped and expected that we in this country will not be behindhand in the welcome which will be extended to our foreign *confrères*.

The congress will be opened at the Albert Hall, and the business part of the proceedings will be held in the buildings of the University of London, the Imperial Institute, and the Imperial College of Science and Technology at South Kensington. The chief aim of the congress is the advancement of scientific knowledge, but beside this, arrangements are being made for various gatherings of a social nature, such as a banquet at the Crystal Palace, a conversazione at the Natural History Museum, and a visit to Windsor Castle by special permission of the King.

In view of the fact that more than 3000 visitors are expected to attend the congress, and that it will last a whole week, the expenses will necessarily be heavy. Substantial sums have already been received, but in order that we may in no way be behind other nations in our hospitality, the committee has appealed for further help.

THE HUTTON MEMORIAL MEDAL AND RESEARCH FUND.

SHORTLY after the death of the late Captain F. W. Hutton in 1905, steps were taken by the Philosophical Institute of Canterbury to establish a research fund as a memorial of his many services to New Zealand science. The New Zealand Government recognised the value of Captain Hutton's work by

subsidising the fund to the amount of 300*l*., and a total sum of about 660*l*. was ultimately handed over to the New Zealand Institute.

Of this amount, 100*l*. was set aside for the expenses of striking a bronze medal to be known as the Hutton memorial medal. This medal, a photograph of which is here reproduced, has been designed by Prof. Lanteri, and bears an excellent portrait of the late Captain Hutton, and on the obverse a design emblematical of the fauna and flora of New Zealand, viz. a tuatara (*Splenodon punctatus*, Gray), prominent in the foreground; a kiwi (Apteryx); a cabbage tree (*Cordyline australis*); New Zealand flax bush (*Phormium tenax*), and other New Zealand plants,

while geology is represented by a geological hammer on some rocks in the foreground, and by a volcano in the distance.

The medal is to be awarded from time to time to persons who have made some notable contribution in connection with the zoology, botany, and geology of New Zealand; save in exceptional circumstances it is not to be awarded oftener than once in three years, and the recipient must have received the greater part of his education in New Zealand, or have resided in New Zealand for not less than ten years.

The remainder of the fund has been invested, and the interest on it may be used by the institute for making grants to persons who require assistance in connection with researches in New Zealand's natural history.

Communications with regard to the fund may be addressed to the secretary of the New Zealand Institute, Wellington, or to Dr. Chas. Chilton, Canterbury College, who acted as hon. treasurer until the fund was handed over to the institute.

W. H. HUDLESTON, F.R.S.

WE have to deplore the death, in his eighty-first year, of Wilfrid Hudleston Hudleston, one of the most distinguished of British geologists, whose combined knowledge of the main branches of the science, palæontological, stratigraphical, petrological and chemical, was unsurpassed.

Born at York, on June 2, 1828, he was the son of Dr. John Simpson, of Knaresborough (who married Elizabeth Ward, heiress of the Hudlestons of Cumberland), and he assumed the name of Hudleston, by letters patent, in 1867.

After receiving education in schools at York and Uppingham, he entered St. John's College, Cambridge, and graduated B.A. in 1850. His attention was directed to geology during his last term at college, when he was present at a course of Sedgwick's lectures, but some years elapsed before his interest was concentrated on that subject. The study of law had engrossed much of his time, and he was called to the Bar in 1853, but never practised.

Possessed of independent means, he spent the earlier years of manhood in travel in various parts of Europe and northern Africa. He was ever a keen sportsman, and the subject of ornithology attracted him, probably through his friendship with the late Alfred Newton, whom he accompanied on a visit to Lapland. Thus it was that he became one of the founders of the British Ornithologists' Union; and on December 9 of last year he attended a special meeting, held in the rooms of the Zoological Society, to celebrate the jubilee of the Union, when a gold medal was presented to him in honour of the occasion.

At the age of thirty-four, Mr. Hudleston decided to qualify himself for research work in natural science by courses of instruction which he undertook at Edinburgh, and afterwards at the Royal College of Chemistry in London. His ultimate career was determined in 1866, when he was introduced to John Morris, professor of geology in University College, London. An absorbing interest in geology was aroused by that enthusiastic and gifted teacher, and Mr. Hudleston became a Fellow of the Geological Society in 1867, and joined the Geologists' Association in 1871. To the latter body he gave energetic service for a number of years, being chosen honorary secretary in 1874, and president in 1881; and he conducted a number of notable excursions, his reports on which contain much original information.

The list of his geological publications commences in 1872, and among the more important are a series of papers on the Yorkshire Oolites, and others on the Gasteropoda of the Oolites, published in the Proceedings of the Geologists' Association and in the *Geological Magazine*.

In 1877, in conjunction with the late J. F. Blake, he communicated to the Geological Society a memoir on "The Corallian Rocks of England," giving full particulars of these fossiliferous strata from Dorset to Yorkshire. It is sufficient to say that this paper is to be regarded as one of the geological classics.

In 1892, with the cooperation of the late Edward Wilson, he published "A Catalogue of British Jurassic Gasteropoda," a work embodying all the critical knowledge of the writers. His chief work, one on which he was engaged for more than twenty years, was his "Monograph on the Gasteropoda of the Inferior Oolite," published by the Palæontographical Society (1887–1896).

Mr. Hudleston, who served for several years as secretary of the Geological Society, was elected president in 1892; and he was awarded the Wollaston medal in 1897, soon after the completion of his great work on the Gasteropoda.

Apart from his detailed investigations, Mr. Hudleston was the author of numerous essays, which afford abundant evidence of his shrewd criticism and sound judgment, with not a little dry humour. Among these articles may be mentioned those on the geology of Palestine, on the Tanganyika problem, on the eastern margin of the North Atlantic Basin, on Indian geology, and on the geological history of iron ores.

Mr. Hudleston was elected a Fellow of the Royal Society in 1884. He was one of the founders of the Malacological Society, was president of Section C of the British Association at Bristol in 1898, and was president at times of several provincial natural history societies. In later years, when he acquired a country residence at West Holme, near Wareham, in Dorset, he took an active part in the proceedings of the Dorset Natural History Field Club. He investigated in detail the structure of Creechbarrow Hill, near Wareham, and only last year published an important paper on some well-sections in connection with the local water-supply. He died at his Dorset home on January 29. A biography of him, to which we are indebted for many of the above particulars, appeared in the *Geological Magazine* for September, 1904, accompanied by an excellent portrait and a list of publications.

H. B. W.

NOTES.

DR. HORACE T. BROWN, F.R.S., and Sir David Bruce, C.B., F.R.S., have been elected members of the Athenæum Club under the provisions of the rule which empowers the election of persons "of distinguished eminence in science, literature, the arts, or for public services."

WE learn from the *Pioneer Mail* that Sir T. H. Holland, F.R.S., director of the Geological Survey of India, may be expected to arrive in England on leave during the coming summer preparatory to retirement, as he proposes to accept the offer of the chair of geology at Manchester University vacated by Prof. Boyd Dawkins, F.R.S.

THE honorary secretaries of the meeting of the British Association to be held in Winnipeg from August 25 to September 1 of this year are Mr. C. N. Bell, Mr. W. Sanford Evans (Mayor), Prof. M. A. Parker, and Prof. Swale Vincent. The office of the secretaries has been organised in the University of Manitoba, Winnipeg, Canada.

SIR DANIEL MORRIS, K.C.M.G., late Imperial Commissioner of Agriculture for the West Indies, has been selected for the newly created office of scientific adviser to the Secretary of State for the Colonies on agricultural matters relating to British possessions in the tropics.

MR. R. R. TATLOCK has been elected president of the Society of Public Analysts for the ensuing year.

MR. O. J. R. HOWARTH has been appointed assistant secretary of the British Association in succession to Mr. A. Silva White, who recently resigned that office.

DR. F. H. HATCH has been appointed by the Government of Natal to make an examination of the mineral resources of the colony, and will shortly proceed to South Africa for that purpose.

A REUTER message from Messina states that a strong earthquake shock was felt there on February 7 at 9.30 p.m., followed by a slighter one half an hour later. Another shock of some violence occurred at 9 a.m. on February 8.

ON Thursday next, February 18, Dr. Hans Gadow, F.R.S., will begin a course of three lectures at the Royal Institution on "Problems of Geographical Distribution in Mexico." The Friday evening discourse on February 19 will be delivered by Sir Henry Cunynghame on "Recent Advances in Means of Saving Life in Coal Mines."

THE Turin Academy of Sciences, says *La Nature*, will award in 1911 a prize of 9300 francs, bequeathed by M. Bressa, to the man of science or the inventor of any nationality, who in the period 1907 to 1910 shall have made, in the judgment of the Turin Academy, the most distinguished and useful discovery, or have produced the most celebrated scientific work in some branch of science.

THE second meeting of the Spanish Association for the Advancement of Science, which was founded on the occasion of the Saragossa Exhibition, will be held at Valence next October. According to the *Revue scientifique*, two meetings will be held in 1910, one in Spain and the other at Toulouse. Particulars of the meetings may be obtained from M. Ricardo Garcia Merat, general secretary of the Royal Spanish Society of Sciences, at Madrid.

THE fifth meeting of the Prehistoric Congress of France will be held at Beauvais on July 26–31 next. The first three days will be devoted to the discussion of papers, and the remaining three to scientific excursions. An exhibition of prehistoric specimens will be held during the meeting. All information may be obtained from M. L. Giraux, the treasurer to the committee, 9 bis, avenue Victor-Hugo, à Saint-Mandé (Seine).

THE death is announced in *Science* of Prof. B. H. Guilbeau, professor of zoology at the Louisiana State University. Since 1906 Prof. Guilbeau had been director of the Gulf Biologic Station. In summer work at Cornell he investigated the froth production of the "spittle insects." At the time of his death he had been engaged for several months investigating the parasites of *Plusia brassica*, confirming the results of French investigators as to the development of many insects from a single egg.

THE gold medal of the Royal Astronomical Society has this year been awarded to Prof. O. Backlund, director of the observatory, Pulkowa, Russia, for his researches on Encke's comet. The medal will be presented at the annual general meeting of the society on Friday, February 12, when the president, Mr. H. F. Newall, F.R.S., will give an address, setting forth the grounds upon which the award has been founded. The Jackson-Gwilt (bronze) medal and gift have been awarded to Mr. P. Melotte, for his discovery of the eighth satellite of Jupiter.

THE following have been elected as officers and council of the Royal Microscopical Society for the ensuing year:—*President*, Sir E. Ray Lankester, K.C.B., F.R.S.; *vice-presidents*, Mr. F. J. Cheshire, Rev. W. H. Dallinger, F.R.S., Sir Ford North, P.C., F.R.S., Mr. E. J. Spitta; *treasurer*, Mr. W. E. Baxter; *secretaries*, Dr. R. G. Hebb, Mr. J. W. Gordon; *ordinary members of council*, Mr. F. W. Watson Baker, Mr. A. N. Disney, Dr. J. W. H. Eyre, Mr. E. Heron-Allen, Mr. H. G. Plimmer, Mr. Thomas H. Powell, Mr. C. Price-Jones, Mr. P. E. Radley, Mr. Julius Rheinberg, Mr. C. F. Rousselet, Mr. F. Shillington Scales, and Mr. D. J. Scourfield.

ON Thursday, February 18, there will be a discussion at the Linnean Society on the subject of alternation of generations in plants. The discussion will be opened by Prof. W. H. Lang, who has just published an article, in the *New Phytologist* for January, on "A Theory of Alternation of Generations in Archegoniate Plants based upon Ontogeny." It is expected that Prof. F. O. Bower, F.R.S., Prof. J. Bretland Farmer, F.R.S., Prof. F. W. Oliver, F.R.S., Dr. D. H. Scott, F.R.S., and Mr. A. G. Tansley will be among those taking part in the discussion, which is likely to be of considerable interest, as the subject is of fundamental importance to botanical morphology, and is one on which botanists have hitherto taken very divergent views.

ONE of the most puzzling features of the reports of the Italian earthquake in the daily papers has been the absence of any news from the interior of Aspromonte. A correspondent to the *Hampshire Chronicle* fills this gap with an account of the medical expedition which was dispatched from Bologna; leaving the coast towns, this struck into the interior, and reached Oppido eight days after the earthquake, to find that they were the first, and only, relief expedition to reach the communes of Oppido, Scido, and Delianuova, where it was found that most of the houses had been destroyed and those still standing were uninhabitable. This district was one of the centres of destructive violence in 1783, and it is interesting to be able to add another to the many analogies between the earthquakes of that year and of 1908.

IN the issue of NATURE for April 20, 1905 (vol. lxxi., p. 595), an account was given of the work of Mr. J. B. Millet, of Boston, Massachusetts, on submarine signalling by sound, which he described at the annual spring meeting of that year of the Institution of Naval Architects. The recent wreck of the *Republic* and the subsequent events, in which use was made of the method, has brought submarine signalling prominently before the public, and it is suggested that the Government should supply our principal lightships with bells. It has been found that the bells can be heard usually at a distance of ten miles, and sometimes of twelve or fifteen miles. Ships fitted with a receiving apparatus can, by using the telephone receiver in the chart room in thick weather, pick up the sound from an ordinary bell-buoy which cannot be heard by the ear alone. We learn from an article in the *Times* that the lightships which already possess bells are the *Royal Sovereign*, *Tongue*, *East Goodwin*, and *Outer Dowsing*. Bells are about to be installed on the *Outer Gubbard*, *Shambles*, *Spurn*, and *Owers* lightships.

MR. QUARITCH has forwarded to us a copy of a catalogue of books on natural history, containing many rare volumes from the library of a naturalist and collector now abroad, and some herbals from that of the late Lord Amherst of Hackney.

COLOUR-VARIATION in some British slugs formed the subject of Mr. W. E. Collinge's presidential address to the Conchological Society in October last, the address, of which we have been favoured with a copy, being published in the *Journal of Conchology*. Colour-variations of a major and a minor type have long been known to occur in the two species forming the subject of the investigation, but the author is of opinion that even the better-marked variations are far less constant than has been hitherto supposed to be the case, while the minor ones are almost endless, and appear of little importance to the naturalist.

To Dr. E. Rey, of Leipzig, we are indebted for a separate copy of a preliminary paper from vol. xxxiv. of the *Ornithologischer Monatschrift*, in which are recorded the results of an examination of the contents of the stomachs of a number of insectivorous birds. The various insects (together with other invertebrates) found therein are tabulated according to their orders, and in the case of the beetles according to their families, those that are harmless being entered in one column and those that are injurious in a second, while such as come under neither of these headings are assigned a third column. The ultimate object of the investigation is to show to what extent insectivorous birds are beneficial to the agriculturist, but further examinations are essential before definite conclusions can be formulated.

BULLETIN No. 136 of the Bureau of Plant Industry of the U.S. Department of Agriculture is devoted to an article, by Mr. O. F. Cook, on methods and causes of evolution. The doctrine of evolution is now being made of practical use in the solution of problems connected with breeding and acclimatisation, and the paper is written to a great extent from this point of view. The author commits himself to the opinion that "evolution is not caused by the struggle for existence, nor limited to characters of environmental fitness. Harmless and even harmful characters may be acquired by species in the same way as beneficial adaptations." This is endorsed by Dr. A. G. Bell, who communicated the following comment quoted in the letter of transmittal:—"I, too, entertain the feeling that natural selection does not, and cannot, produce new species or varieties, or cause modifications of living organisms to come into existence. On the contrary, its sole function is to prevent evolution. In its action it is destructive merely, not constructive—causing death and extinction, not life and progression. Death cannot produce life; and though natural selection may cause the death of the unfit, it cannot produce the fit—far less evolve the fittest. It may permit the fit to survive by not killing them off if they are already in existence; but it does not bring them into existence or cause improvement in them after they have once appeared. We must look to other agencies for the causes of evolution."

THE tenth number, completing the volume for 1908, of the *Kew Bulletin* was issued last month. It contains determinations of new plants, chiefly from Africa and India, also a letter descriptive of a journey in the Nelson district of New Zealand, by Captain A. A. Dorrien-Smith. A note on the poisonous plant *Rhus toxicodendron*, that grows either as a shrub or a climber, is intended to remove the confusion, caused by recent inaccurate descriptions, between the leaves of this plant and of the harmless unrelated plant, *Ampelopsis Veitchii*.

IN the tenth (1908) number of the *Kew Bulletin* an article on the drug *cascara sagrada* furnished by the bark of two American plants, *Rhamnus Purshiana* and *Rhamnus californica*, is published with a view to the possible introduction of these trees into cultivation on the western coasts of the British Isles. The species *Purshiana* has made successful growth at Kew, and a chemical report on the bark pronounces the extract made from it to be indistinguishable from the product of American bark. There is a difficulty in getting fertile seed which has so far been imported, but where plantations are once formed coppice reproduction might be relied on, judging from the abundance of shoots produced from the stump of a tree cut down at Kew. *Rhamnus californica* is not recommended for cultivation in Great Britain.

FOR the inception of the new botanical publication, *Zeitschrift fur Botanik*, that has been initiated in circumstances already explained in NATURE, the editors have been fortunate in securing an original article by Dr. H. Fitting on the effect of pollination and other influences on orchid flowers. The experiments carried out in Buitenzorg tend to show that post-floration changes are not the necessary consequence of pollination, although it normally provides the stimulus; thus, premature withering of the flowers and swelling of the gynostemium can be induced by smearing the stigma with dead pollen or an extract of pollen juice, although growth of the ovary does appear to depend upon the formation of the pollen-tube. The number, running to about 100 pages, contains also critical notices of recent publications, and an index to new literature arranged as in the *Botanisches Centralblatt*, which it resembles in form and appearance.

THE phytogeographical account of the littoral and alluvial districts of Belgium by Prof. J. Massart published in the seventh volume of the *Recueil de l'Institut botanique Léo Errera*, provides a remarkably comprehensive and attractive study of the conditions and associations existing there. The author discusses the past history of the region, the action of climate and soil, morphological modifications, the associations of plants, and the origin of the flora. A primary distinction is drawn between the clay soils of the estuaries and of the *polders*—the low-lying lands retained by the system of dykes—and the sandy soils of the dunes. The latter are bound with such typical species as *Ammophila arenaria, Carex arenaria*, and *Eryngium maritimum*, while *Salix repens* and *Hippophae rhamnoides* are dominant in the hollows. Occasionally plantations of alders or Scots pine are attempted, and in parts crops of potatoes and secale are raised. The nature of the associations is well shown in the photographs, which, with several charts and a list of plants, are published in a separate part. The flora differs from the northern littoral floras by the inclusion of calciphilous elements, and resembles the flora of the French littoral, with which it shares a southern origin.

WE learn from the *North British Agriculturalist* of January 21 that a new process for sterilising milk has been tried at Edinburgh under the superintendence of the inventor, Dr. Budde, of Copenhagen. It depends on the presence in milk of an enzyme, catalase, which decomposes hydrogen peroxide with liberation of oxygen. The milk is heated to 120° F., and treated with hydrogen peroxide; after a time the pathogenic organisms are destroyed, and the milk is run into sterilised bottles fitted with air-tight stoppers, and is then ready for delivery.

TEACHERS in agricultural schools and colleges will welcome the set of wall pictures recently issued by Messrs.

Macmillan and Co., Ltd., to illustrate various breeds of farm animals. Text-books containing sufficiently good illustrations to show what is wanted are too costly for class work, and photographs are not altogether suitable. These pictures are of a good size (30 inches by 20 inches), they depict good examples of the breed, and they are coloured. The set of six includes the thoroughbred horse, the Shire horse, the Shorthorn cow, the Ayrshire cow, Lincoln and Southdown sheep, Large White and Berkshire pigs.

THE *Journal of Agriculture of South Australia* for November, 1908, contains a short paper on the poisonous properties of the Cape tulip. Two species of this plant are found in South Australia, both imported from South Africa: *Homeria miniata*, the two-leaved Cape tulip, and *H. collina*, the one-leaved Cape tulip; the latter is the taller and handsomer, and is sometimes cultivated in gardens. The experiments recorded show that the plant is poisonous, but is carefully avoided by animals that regularly graze on land infested with it. There is some danger, however, that animals newly arrived and hungry may eat the plant, with serious consequences.

WE have received from Prof. Potter a copy of a paper recently published by him in the *Journal of Agricultural Science*, in which he suggests a method not hitherto tried for checking parasitic diseases in plants. It is well known that the waste products of metabolism, when permitted to accumulate beyond a certain stage, are inimical to the organism, gradually checking growth and producing results which finally prove fatal. By growing a pathogenic organism (*Pseudomonas destructans*) in a culture medium, he obtained a toxic solution which, on inoculation into a turnip suffering from the disease caused by this organism, completely inhibited further progress of the disease. The method promises to be distinctly useful in dealing with plant diseases.

MR. A. R. HORWOOD has embodied the results of an investigation, ranging over six years, of the fossil flora of the Leicestershire and south Derbyshire coalfield in a paper read before the Leicester Literary and Philosophical Society, and published in vol. xii., part ii., of the Transactions. The main object was to obtain evidence that would fix the position of the local Coal-measures in the British Carboniferous series. In the case of fossil plants such evidence is derived from the general collection rather than from any specific types. A few of the recorded species are rare, such as *Calamocladus lycopodioides* and *Neuropteris callosa*; also it is interesting to learn that Leicestershire provided the type of *Trigonocarpus Parkinsoni*, a seed that has been assigned to the group of fossil plants known as pteridosperms.

A CURIOUS instance of the light which may be thrown by anthropology on the system of Egyptian hieroglyphics is recorded by Mr. A. M. Blackman in the January issue of *Man*. The symbol representing the word *msy*, "to give birth," has been interpreted by Dr. Borchardt in the *Zeitschrift für Ägyptische Sprache* (December, 1907) to be derived from a fly-flap made of fox skins. Mr. Blackman has now found in Nubia that dead foxes are hung over the doors and on the roofs of houses as a charm to protect the women inmates from malignant influences at the time of childbirth. It follows, therefore, that the use of the symbol derived from a fly-flap was a secondary idea, the primitive conception on which it was based being its use as a birth amulet.

THE London County Council is doing useful work in popularising the study of anthropology by the issue of a series of guides to the collections in the Horniman Museum, Forest Hill. The last number, entitled "A Handbook to the Weapons of War and the Chase," is the work of Dr. H. S. Harrison, the curator of the museum, is edited by the advisory curator, Dr. A. C. Haddon, and is published at the modest price of twopence. After a short introduction dealing with the origin and primary characteristics of weapons, we have a series of articles describing the various types, of which those on clubs of various kinds, spear-throwers, and the composite bow may be specially commended. Unfortunately, only two plates are supplied. If the book were issued in a better form, with superior illustrations, it might be a useful addition to the library of the anthropologist.

THE *Journal of Hygiene* dated November last (viii., No. 5), though only just issued, contains an important paper by Miss Chick and Dr. Martin on the process of disinfection, in which a number of factors modifying the velocity of disinfection is discussed and the conditions necessary for determining the germicidal power of disinfectants and their standardisation detailed.

IN a report of the Board of Health, New South Wales, which has recently reached us, Dr. Ashburton Thompson gives details of an outbreak of plague (the seventh) at Sydney in 1907. Forty-seven cases occurred, of which sixteen ended fatally. For some years now the health staff has instituted a crusade against the rats, large numbers of the rodents being systematically destroyed, and a proportion of them examined bacteriologically. As in previous epidemics, numbers of the rats were found to be infected with plague during the epidemic period. In fact, the careful investigations of the Sydney Board of Health have demonstrated in successive epidemics the close connection that exists between plague in rats and plague in man.

THE subject of dangerous trades is one which has rightly attracted the attention of the public, and a hitherto unsuspected source of danger was recently brought to light in relation to the carriage and storage of the substance known as ferro-silicon. This material is manufactured by heating a mixture of iron ore, quartz, coke, and lime in an electric furnace, and is used by steel makers as a convenient method for the addition of silicon to certain grades of steel. A cargo of this material was being conveyed from Antwerp to Grimsby in December last, and five Russian immigrants in the steerage were found dead in the morning, their symptoms suggesting cholera. No suspicion of a dangerous cargo existed, and the necessary measures of precaution were taken by the Grimsby authorities. The viscera were sent to the laboratories of the Royal Institute of Public Health, and no true cholera organisms were discoverable. The subsequent investigations carried out by Dr. Dodd, Dr. Harris, and Prof. W. R. Smith at the laboratory seem to prove beyond question that death resulted from poisonous emanations from the ferro-silicon. When dry this substance emits no fumes, but when powdered and moistened fumes were formed, and proved fatal within a few hours to animals in the immediate neighbourhood. It was proved that arseniuretted hydrogen is produced in small quantities, but the chief gas evolved is phosphoretted hydrogen, a gas which is so poisonous that 0·02 per cent. of it in air is fatal to small animals within half an hour. Now that the source of danger is known, one can only hope that in the future suitable precautions will be taken to prevent the recurrence of fatalities similar to those which have led to the discovery of the danger.

The Meteorological Office has recently published an English edition of the report of the meeting of the International Meteorological Committee at Paris in September, 1907. The consideration of the classification of meteorological stations, and of the definition in a clear and precise manner of the terms used for frozen aqueous vapour, referred to the committee by the conference at Innsbruck (1905), was postponed. Among the various subjects discussed we may mention a proposal of the Rev. L. Froc (Zi-ka-wei) for a system of signals for communicating to ships the information at present sent to sea-ports, &c. After a long discussion a special commission was appointed to report upon the question; the same commission was requested to report upon a proposal by Dr. Shaw for uniformity in the scale and projection of marine meteorological charts. After an exhaustive discussion of questions raised by Dr. Shaw and Mr. Nakamura relating to mean values of climatological data, the committee decided to request directors of meteorological systems to enumerate the publications containing such information for long periods for their countries. This resulted in the publication in the present report of a very valuable appendix giving references to such data. Special commissions were appointed to consider proposals for the publication of new isothermal charts (Prof. J. Hann) and daily weather reports for the whole globe (M. Teisserenc de Bort). Dr. Hellmann's proposal that a commission should be appointed to deal more especially with the question of wireless telegraphy was adopted. Dr. Shaw and Dr. Hellmann were respectively elected president and secretary of the International Committee in place of MM. Mascart and Hildebrandsson. Reports of commissions on terrestrial magnetism, aëronautics, and solar physics are printed in the appendices.

A paper on a practical method for the improvement of existing railway curves was read by Mr. W. H. Shortt at the Institution of Civil Engineers on January 12. The subject-matter comprises methods for the introduction of transition curves for connecting straight lines with circular curves, and also for connecting reversed curves at the reversal of curvature. The paper should be of service in pointing out the scarcity of such relieving curves on existing lines in this country, a defect which leads to damage of both line and rolling stock, and also contributes in no small degree to the discomfort of the travelling public.

The claims of the propeller problem are advanced by Mr. J. Hamilton Gibson in an article on the efficiency of marine engines and propellers in the *Engineer* of January 29. The power developed by marine turbine machinery is measured by application of a torsionmeter, by means of which the angle of twist of a measured length of the propeller shaft is ascertained and taken as a measure of the torque passing through the shaft. The necessity of calibrating the shaft on which the instrument is to be used is shown from the results of experiments on apparently identical shafts, in which the value of the modulus of rigidity was found to vary from 11,500,000 lb. to 12,500,000 lb. per square inch, a variation which would introduce an error of nearly 9 per cent. had the same value of the modulus been assumed for all. Mr. Gibson has had great experience with torsionmeters, and makes some useful recommendations. Torsionmeter shafts should be periodically re-calibrated. The torque in turbine-driven shafts is found to be remarkably steady, consequently there is but small interference in the torsionmeter readings due to torsional oscillations of such shafts. Methods of obtaining the zero reading are described; this should be done at the commencement of each trial. Data obtained from torsionmeter trials point to a marked inefficiency of the small high-speed turbine-driven propeller as compared with the large low-speed piston-driven screw, and Mr. Gibson suggests the need for a trustworthy thrust indicator which would indicate the amount of compression on the shaft, and thus enable turbine-driven propellers to be compared direct with piston-driven screws. Experiments on multiple-bladed propellers are also suggested, the analogy of modern windmills, fans such as the Sirocco, and many vaned water turbines being cited. Meanwhile, trial-trip data alone are available until some public-spirited firm takes upon itself the responsibility and cost of carrying out experiments on full-sized propellers.

The *Physikalische Zeitschrift* for January 15 reproduces an address by Prof. M. Planck to the science students at the University of Leyden on the unity of natural philosophy, in which he dealt mainly with the recent tendencies of theoretical physics, and pointed out how marked had been the absorption by electrodynamics of branches of the subject formerly distinct. In his own field of work he dwelt at length on the greater precision which had been introduced into the study of thermodynamics by the reduction by the late Prof. Boltzmann of the idea of entropy to that of probability. From this, since the entropy of two independent systems is the sum of their separate entropies, while the probability of the two systems is the product of their separate probabilities, it follows that the entropy of a system is proportional to the logarithm of its probability. Finally, Prof. Planck pointed out the directions in which future advances will be made, and predicted much discussion of these fundamental questions, for, as he said, "theorists are many and paper is patient." He pleaded above all for conscientiousness in self-criticism and avoidance of personalities in the controversies which must arise.

We have received from Messrs. W. and J. George a new simplified form of burette stand, which they designate the W.J. Burette Stand. It consists of a stout upright fastened to the usual form of base, both of which are of teak. The upright, of wood, has two permanently fixed arms, which are 9 inches apart. The arms are placed directly above each other, and are slotted so that a burette can easily pass into them. In order to hold the burette in position the wood at the sides of the slots is countersunk in the form of a ring about half-way down its thickness. To fix the burette in position two circular rubber bands are placed over it at such a distance apart that they will just rest upon the counter-sunk part of the arms. There are no screws to turn or get out of order, and by simply slipping the burette between the slots it falls into position without any further adjustment. For elementary students this is certainly a very simple stand, and one which cannot get out of order. The stand was invented and patented by the Rev. A. Wentworth Jones.

Messrs. Jaeger and von Steinwehr have recently completed at the Physikalisch-Technische Reichsanstalt, Charlottenburg, an exhaustive research on the silver voltameter, in connection with which comparisons of Weston normal cells have also been made (*Zeitschrift für Instrumentenkunde*, November and December, 1908). These two experimenters have arrived at the following conclusions:—(1) The weight of silver deposited in the voltameter does not, within the errors of experiment, depend on whether the Rayleigh form or the Richards modification is employed. The absolute measurements show a difference of 1 part in 10,000, but it was not possible to find a measurable difference in the exact relative measure-

ments. (2) By displacing the air during electrolysis with a neutral gas (nitrogen) no appreciable difference was observed in the weight of silver deposited; this is in agreement with the recent measurements made at the National Physical Laboratory, and contrary to the older measurements of most of the earlier observers. (3) The value found in the course of this research for the Weston normal cell, in terms of the international ohm and international ampere, agrees in a most satisfactory manner with the same results of the Reichsanstalt in 1908, and shows a satisfactory agreement with the recently published results of the National Physical Laboratory.

THE explanation of the electrical and thermal properties of metals as due to the existence of freely moving electrons in the intervals between the molecules of the metal has been a favourite theme with physicists for the last ten years since Prof. Riecke first published his theory. Although most of the theories have succeeded in giving properties for the metals in general agreement with the results of experiment, the quantitative agreement has not been all that could be desired. In particular, the quotient of the electrical and thermal conductivities, which has throughout been a favourite quantity with regard to which theory and experiment were compared, has, according to the theories, been a simpler function of the temperature than experiment has proved it to be. In No. 13 of the *Verhandlungen der deutschen physikalischen Gesellschaft* for 1908 Prof. P. Gruner, of Berne, suggests a modification of the theory of Prof. Lorentz which will do something to remove this objection. The negative electrons alone are supposed to be in motion, and when one impinges on a neutral molecule with sufficient velocity it is supposed to be capable of expelling an electron from the molecule, and when it impinges on a positive molecule with the requisite gentleness it may combine with the molecule. Since the critical velocities can be chosen at will, it is evident that Prof. Gruner's theory admits of a closer fit between theory and experiment than has hitherto been possible.

THE general report on the operations of the Survey of India administered under the Government of India during 1906–7 has been received. The report was prepared under the direction of Colonel F. B. Longe, R.E., Surveyor-General of India. We notice that the scale on which field surveys are to be executed and the larger scale standard maps published has been decided. The general scale of survey is to be 1 inch = 1 mile, but reserved forests and special areas will be surveyed on the scale 2 inches = 1 mile if required. The general scale for publication will be 1 inch = 1 mile. Among special observations carried out during the year under review may be mentioned those in connection with the gravimetric survey. The deflection of the plumb-line was determined at eleven stations in Káthiáwár and round the Gulf of Cambay, and the values obtained were in accordance with the general character of the deflections in Rajputana. Pendulum observations to determine the variation in the value of gravity were made at twelve stations in the neighbourhood of the Himalayas and of the Siwáliks, and on or near the Great Arc. The general character of the variations found was in accordance with expectation, but local anomalies of considerable amount were also disclosed. The results obtained have been found to agree with those obtained by Prof. Hecker in 1905. The magnetic survey was extended during the year into Burma and Assam. The systematic observations of Himalayan peaks in connection with the problem of refraction were continued, and though the results are of great interest many more are required before definite conclusions can be drawn. The total out-turn of detailed topographical and forest surveys on all scales was at the time of the report 25,740 square miles, against 23,312 square miles of similar surveys during the previous year. The total area triangulated and traversed for survey purposes was 31,851 and 1684 square miles respectively, against 27,134 for the previous year.

MESSRS. BOWES AND BOWES, of Cambridge, have just issued their latest catalogue of books on pure and applied mathematics, dealing more particularly with books published in the nineteenth century.

PROF. J. PERRY'S well-known work on "Applied Mechanics" has been translated into German by Herr Rudolf Schick. "Angewandte Mechanik" is published by the firm of Teubner, of Leipzig and Berlin, at the price of 18 marks.

FOUR new volumes in the Philosophische Bibliothek published by the Dürr'schen Buchhandlung, Leipzig, have been received. No. 28 deals with Descartes's principles of philosophy, and is edited by Dr. A. Buchenau; some of the Emperor Julian's philosophical works, translated and explained by Herr R. Asmus, form No. 116; a critical analysis of Schleiermacher's "Weihnachtsfeier," by Herr H. Mulert, appears as No. 117; and No. 118 is an "Einführung in die Erkenntnistheorie," by Prof. A. Messer.

MESSRS. CHAPMAN AND HALL have published a third edition of Mr. Frederick Hovenden's book, "What is Life? or Where are we? What are we? Whence did we come? And whither do we go?" The first issue of the work was reviewed in NATURE for April 7, 1898 (vol. lvii., p. 535), and it is sufficient to say that the present edition has been revised in the light of the progress made since the publication of the last edition, and an appendix has been added.

THE Johns Hopkins University Circular for December, 1908, takes the form of a memorial volume to the late President D. C. Gilman, first president of the Johns Hopkins University, who ruled its destinies from 1876 to 1901. The circular contains the impressive and appreciative addresses, delivered at the *in memoriam* services held last November at the University, by the present president, Dr. Ira Remsen, many of the University administrators and professors, and by Dr. James Bryce, our Ambassador at Washington. Numerous letters eulogising the late president received by President Remsen are included, an article from the *Nation*, and a biographical sketch.

OUR ASTRONOMICAL COLUMN.

WATER-VAPOUR LINES IN THE SUN-SPOT SPECTRUM.—In a paper read before the Dublin meeting of the British Association, and again in No. 5, vol. xxviii., of the *Astrophysical Journal*, Father Cortie directed attention to certain water-vapour lines in the solar spectrum which appear to become intensified in the spot spectrum. Examining ninety-one lines in the region D_1 to λ 5953·386, sixty-four, or 70·3 per cent., of which are due to water vapour, he found that of the sixty-four, twenty-nine, or 45 per cent., are affected in the spectrum of the spot either as widened or darkened lines. An examination of Hale's map showed that sixteen of these twenty-nine lines were also shown there as widened or darkened.

On this evidence Father Cortie suggested that steam may exist in the regions of sun-spots, and supported the suggestion by Mr. E. E. Brook's statement that he found the presence of water vapour essential for the laboratory production of Fowler's magnesium hydride bands, bands which are a prominent feature of the spot spectrum.

In No. 406 of the *Observatory* (p. 101, February) Mr. Evershed discusses the same subject from the observations made at the Kodaikanal Observatory. Dealing with the water-vapour lines of intensity 1 or more given by Rowland between λ 5850 and λ 6000, seventy in all, he finds that thirteen are not shown on his plates, forty-two are absolutely unaffected, seven are weakened, and eight are strengthened. Of the latter, four are only doubtfully strengthened; in two the strengthening is shown to be due to close titanium companions, and two are decidedly darkened. Mr. Evershed concludes that the weight of evidence is against the probability of the existence of steam in sun-spots, but, in commenting on this conclusion, Father Cortie points out that the conditions of observation at Stonyhurst and Kodaikanal were dissimilar, that the water-vapour lines recorded as strengthened at both places still have to be accounted for, and that the collateral evidence from the laboratory must also be taken into account.

THE SPECTRUM AND FORM OF COMET MOREHOUSE.—The *Astrophysical Journal* for January (No. 1, vol. xxix.) contains three papers dealing with Morehouse's comet, 1908*c*. In the first of these Prof. Frost and Mr. Parkhurst describe and discuss two series of spectrograms taken with objective-prism or with slit spectrographs, respectively, at the Yerkes Observatory. As the scale of the spectra is in each case very small, $H\beta$ to $H\theta$ covers about 3 mm., the wave-lengths are only approximate, but comparisons with the hydrogen lines in the spectrum of Vega, taken on the same plate with the "slit" spectra, permitted the recognition of several of the cometary condensations.

The results differ from those previously published by MM. Pluvinel and Baldet in that the Yerkes observers find the third and fourth "carbon" (hydrocarbon?) bands, whilst the Juvisy observers did not. Again, the CN band at λ 4216 could not be detected on the Yerkes spectrograms, whereas the Juvisy observers found that cyanogen was fully represented; both sets of observations agree on the absence of continuous spectrum, but are not in agreement in the matter of the wave-lengths of the bands. On the other hand, the Yerkes wave-lengths agree with those of MM. Deslandres and Bernard, but the latter were unable to identify the "carbon" bands, and they found a continuous spectrum on all their plates.

A study of the relative intensities of the spectra of the head and of the streamers leads to some important results. First, of the monochromatic images of the head, those at λλ 471 and 388 are strong, but no corresponding tail images are shown, or are very weak, thus indicating that the matter producing these radiations is mainly confined to the comet's head. Again, the tails diverging at different angles are shown in the same monochromatic images, thus indicating that they are composed of the same materials.

The second paper is by Prof. Barnard, and in it he describes his latest photographs of the comet. The changes in form which occurred in the tail strengthen his belief that the ejected matter met with resisting media, probably meteor swarms, in space.

Spectrograms, obtained with a slit spectrograph at the Lick Observatory, are described by Prof. Campbell and Dr. S. Albrecht in the third paper. They recognise the different edges of the third and fourth carbon and the first and third cyanogen bands, but the second cyanogen band is missing. Unknown lines at λλ 3913, 4002, 4022, 4255, 4276, 4540, and 4570 are also shown on the spectrograms, and it is suggested that the last six may be related bands, similar to those of cyanogen, due to some substance as yet unknown terrestrially.

PARALLAX OF 23 H CAMELOPARDALIS.—From a photographic investigation, Herr Gustaf Strömberg finds that the parallax of 23 H Camelopardalis is $\pi = +0''.127$, $\chi = -0''.010$, with probable errors of $\pm 0''.053$ and $+0''.057$ respectively, where χ is the relative correction of the aberration constant. These values were obtained by the measurement and discussion of twenty-eight plates taken between October, 1904, and April, 1908, twenty-three being employed for the estimation of the difference in right ascension and twenty-five for that in declination (*Astronomische Nachrichten*, No. 4295, p. 366).

THE STARS OF THE *c* AND *ac* SUBDIVISIONS IN THE MAURY SPECTRAL CLASSIFICATION.—In No. 4296 of the *Astronomische Nachrichten* Herr E. Hertzsprung discusses the distance, distribution, and probable general characteristics of the stars which in Miss Maury's classification of the "Spectra of Bright Stars" (Harvard) are placed in the subdivisions *c* and *ac*. From the discussion of their proper motions, parallaxes, &c., the author finds, among other conclusions, that these stars, among which many of the brightest stars in the heavens are included, are generally at a greater distance and intrinsically brighter than those of the other groups.

THE STARS SURROUNDING 59 CYGNI.—No. 25 of the Contributions from the Observatory of Columbia University contains the measures of the Rutherfurd photographs of stars surrounding 59 Cygni. The measures are discussed by Prof. Jacoby, and in the final catalogue the positions (1875·0), magnitudes, &c., are given for forty-six stars.

ERRORS OF DOUBLE-STAR MEASURES.—In Nos. 4298–9 of the *Astronomische Nachrichten* (pp. 17–39, January 22) Dr. H. E. Lau discusses the systematic errors of double-star measures, and gives in detail the peculiar errors of a large number of well-known observers. In each case a brief note gives the mean probable error at different distances and in position-angle; the magnitude equation of each observer is also discussed.

ELECTRIFICATION OF RAILWAYS.

Present Position.

SINCE the position of railway electrification was last reviewed in these columns, a number of important developments have taken place on the Continent and in America. In England the conversion of steam lines has been slower than was anticipated. On the Continent, however, its spread has been quite as rapid as was expected by any but the too optimistic.

Electrification may be considered under practically the same heads as railways themselves. That is to say, the problem is quite different according to whether the application be to main line, suburban, or purely urban traffic, while the handling of goods traffic introduces an additional consideration.

As regards the advantages of electricity for handling urban traffic there is practically no longer any discussion. Thus most of the purely urban systems in the great capitals of the world, such as the tubes, District, and Metropolitan Railways in London, the Metropolitan in Paris, the subways in New York, and the railways in Berlin and Chicago, so far as they are self-contained, are now electrically worked, steam where previously in use having been replaced.

As regards suburban lines, especially where this is carried over lines which are also used for main-line traffic, the process has not been carried so far. There are, of course, plenty of instances where the conversion has taken place both in the neighbourhood of great capitals and in less populous districts. Thus in London the Harrow extension of the Metropolitan and portions of the Great Western and South-Western now use electricity. In New York the New York Central and the New York, New Haven, and Hartford lines are now working electrically, and the Pennsylvania tunnels are being rapidly equipped. In Chicago the Illinois Central is now considering the electrification of a large number of suburban lines, while an extension of electric working to most of the suburban lines in the Berlin district will probably take place before long. In Melbourne the Railway Commissioners have recently had before them the whole question of converting their suburban system, upwards of 200 miles, to electric working. In London, however, the application of electric working to the suburban sections of the great main lines has made little progress. The Brighton Company has been engaged for some years in converting a portion of its suburban system between Victoria and London Bridge, and the result of that experiment, both financially and technically, will doubtless have its result upon the other companies. A trial trip was made a few days ago.

There are two principal factors, however, which have somewhat lessened the urgency of the electrification problem on London suburban lines.

Suburban Congestion.

A few years ago the principal trouble from which the London suburban railways were suffering was the congestion at their termini, and enormous sums of money were consequently spent on enlarging these termini and increasing the facilities for handling suburban traffic. Since that time, however, suburban traffic has received a setback. Although the provision of new facilities, such as tubes and the conversion of horse tramways to electricity, has undoubtedly created a very large new traffic, it has also abstracted a large amount of traffic from the older railways, and by that much has lessened the congestion at their termini. Now it is a recognised fact that the adoption of electric traction is not, as a rule, justified upon the grounds of reducing working expenses alone. It is true that it usually enables working expenses to be reduced as compared with steam working, but the saving is seldom, if ever, sufficient to pay for the capital charges on the new expenditure involved, and to justify these additional traffic is required. This additional traffic may or may not be obtainable. In the case of the North-Eastern Railway, in that of the Liverpool and Southport lines, and in that of the Metropolitan District Railway additional traffic has been obtained, but it remains to be seen, in view of the growing competition of electric tramways and motor omnibuses, whether sufficient additional traffic can be obtained upon the other London suburban lines, like those now being converted by the Brighton Company, for instance.

Take the North London Railway, the receipts of which show a steady diminution. Electrification has been more than once mooted, and even considered, but never, we believe, seriously investigated by the board; such preliminary and superficial investigations as have been made have, it is believed, pointed to the fact that the cost of converting the lines would not be justified, at least at present, by the extra traffic obtainable; whether a complete investigation by an expert competent to decide upon the commercial as well as the technical aspects would show a different result is a moot point. It may be, of course, done when the Euston to Watford line is completed, and electricity is adopted on a part of the North-Western system, in view of the intimate relations existing between these two companies. Many of those who are most experienced in this question believe that it would materially assist the latter to stem the steady reductions in receipts which have now been taking place for years, while the difficulty of hauling "foreign" trains over the system, which Lord Rathmore has mentioned, is one which has been surmounted without difficulty at the other end of the "Outer Circle," where the North-Western trains were until recently hauled from Earl's Court to the Mansion House by electric locomotives.

Direct Current and Single-phase.

In spite of the differences of opinion between experts as to the relative merits of the different systems of electric traction in use, especially those of the direct-current and single-phase systems, each of which is in reality suited to a different set of conditions, the real problem of electrification at the present time is a commercial one. The fact that in the past the electrical experts have been apt to lay stress upon the technical side, and have in some cases devoted less attention and study to the purely commercial side than it warranted, has undoubtedly made an unfavourable impression upon the railway director and business man. The engineer of the old school was primarily educated with the idea of designing and carrying out undertakings which would *work*. Only since the beginning of the present century has it been fully grasped that the engineer, and more especially the electrical engineer, whose opinion is to be worth paying for is the one who can make a trustworthy report upon whether the undertaking will *pay*.

The growing importance of this aspect of the question is strikingly illustrated in one of the latest reports upon electric traction, that which the Railway Commissioners of Victoria have recently made public. The keynote of this whole report is whether the application of electric traction to the system under discussion is *financially* justified, and, in the second place only, to determine the best means of applying electric traction if it be justifiable.

More and more it is becoming realised in the railway world that a considerable proportion of the traffic which has been diverted from the railways to tramways and omnibuses is traffic which these latter are more fitted to carry. This diversion of traffic can often be stopped, and in some cases, as has happened on the Tyne, for instance, some of it can even be regained; but in the main, electrification, to be justified, must create fresh traffic, usually that of eight to ten or twelve miles, which is rather beyond the profitable radius of a suburban tramway. Given sufficient inducement to the season-ticket holders, the ten- to fifteen-mile suburban traffic in the neighbourhood of provincial towns, and the fifteen- to twenty-five mile traffic in the neighbourhood of London, is capable of very considerable expansion. The movement of the daily breadwinner to even greater distances from his work is a steadily growing one.

There is, of course, in addition to this, usually a considerable saving in operating expenses even with the same train mileage. When, as is always found advisable, the train mileage after electrification is increased, the reduction in the working expenses per train mile is very considerable.

There is another cause lessening the urgency of London suburban electrification, and that is the reduction in main-line trains now being effected as the result of working agreements, which makes suburban working easier.

The Financial Question.

The Victorian report already referred to shows very clearly and typically the kind of financial change which may be expected to be produced by electrification. This system is a considerable one, with a track mileage of more than 200 and a very dense traffic. The expenses per train mile are 18·9*d.* with steam, and would be 11·0*d.* with electric traction. The total operating expenses with electric traction for the whole suburban system is 27,627*l.* per annum less than with steam, but when the interest on the new capital outlay is added, the total cost of operating would be 44,791*l.* more than with steam. Against this, however, is to be put the additional revenue derived from the improved service, and it is shown that the final result would be a balance in favour of electrification. For some reason or other the figures appear to be based upon a traffic increase of only 5 per cent. as the result of electrification. Why such an exceptionally low figure is taken is not explained, for it is pretty certain from the experience of the District Railway, the North-Eastern Railway, the Manhattan Elevated, and, in fact, almost every system which has been converted, that a very much greater increase than this will certainly result.

In addition to the decrease in the suburban traffics, and consequently the terminal congestion, existing a few years ago, the railway companies with termini in London have felt some hesitation owing to the introduction of the single-phase system. The direct-current system which is used on the Underground and for the majority of heavy suburban electric traction schemes is not now the only one possible.

The single-phase system, which is being adopted by the Brighton Company, and which is used on the lines of the New York, New Haven, and Hartford Company, offers certain advantages over direct current, especially where the ultimate extension of electric traction to main lines is possible. It is, however, more expensive to install, assuming the same degree of security and workmanship, needs heavier rolling-stock, and a greater expenditure of current.

These two causes, together with the natural objection to raising money at the present time and to the desire to wait and see whether the Brighton experiment turns out successful, both financially and technically, have made the question of electrification in the London district fall into abeyance at present. At the same time, it must not be

supposed that the single-phase system is untried. There are in Europe more than thirty different railways, portions of which are now in operation or under construction by single-phase current, aggregating in all more than 850 miles, while in America there are nearly 1000 miles of railways being so operated. Some of these, however, are not heavy electric railways, but interurban electric railways laid down for electric working from the start. Hence before long it should be possible to obtain ample experience of the results of single-phase working. Some of these systems are of considerable length. Thus the Prussian State Railway will have 112 miles electrically worked, while the Berlin Stadt and Ring Railway will have 360 miles, and in America the Spokane Inland Railway Company has 115 miles.

Choice of System.

Many engineers and railway men have unfortunately adopted an attitude of partisanship on this, a question which should be considered primarily on its merits in each particular case. It is quite absurd to generalise and say that the single-phase or the direct-current system is the better. Each has its own field, each is excellent and desirable under its own set of conditions, and only those who have studied all the conditions in each particular case can say which is the best scheme to adopt financially.

As regards main-line working pure and simple, engineers have not yet decided quite as to the best systems of doing it, neither are railway men entirely satisfied as to the financial advisability of converting main-line working; but for heavy working under special conditions electrification is being more and more considered. Thus the Grand Trunk Railway has recently equipped the St. Clair Tunnel for electric working, an installation which is notable as being the heaviest railway service in the world handled by electricity. Trains weighing 1000 tons are hauled from one end of the tunnel to the other, about two miles, at a minimum speed of ten miles per hour on a gradient of 1 in 50. The new tunnels under the Hudson River at New York, by which the Pennsylvania Company will obtain access to Manhattan Island itself, are also being electrically equipped for the haulage of main-line Pennsylvania trains, which are naturally of great weight. A project of a somewhat similar character is that which the Great Northern Railroad of America is considering in connection with the electrification of a new section of line over the Rockies, where the three-phase system, which has been a good deal used in Italy and Switzerland, is likely to be adopted.

Thus it will be seen that there is plenty being done in electrification work. It is to be regretted, however, that actual financial results, especially operating costs, have been very sparingly published. While it is known that the North-Eastern Railway Company, for instance, has been well satisfied with the results of the traffic obtained on its Tynemouth lines, and while the traffics on the District and Metropolitan Railways are now beginning to show steady improvement as the result of electrification, the actual balance-sheet of expenses and receipts has not been made public. A number of preliminary figures regarding the New York Central lines have been published, but they were hardly complete enough and the result of too recent work to be of much value. While as regards engineering experience there is a free interchange of ideas between the different makers and the various engineers concerned, there is less of this as regards traffic receipts.

It is to be hoped that ere long it will be possible for those responsible for the management of lines which are being electrically worked in this country to make public some of the results they have obtained for the benefit of those who are still considering the question.

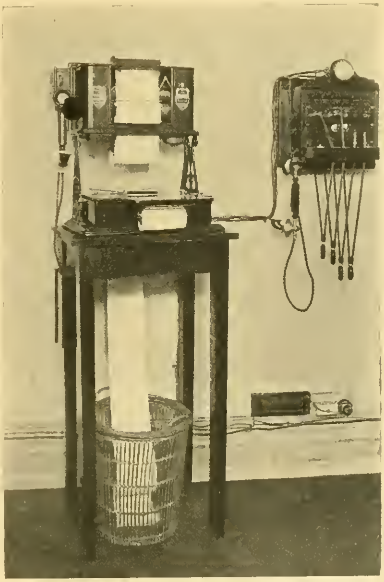
THE TELEGRAPHIC TRANSMISSION OF WRITING.

THE advent of the telewriter should obviate the mistakes and misunderstandings which so commonly occur in business messages transmitted by telephone, and should save the repetition work now necessary owing to messages having to be confirmed by letter.

The telewriter consists of a transmitter and receiver. The message to be sent is written in pencil on a roll of paper attached to the transmitter, and is exactly reproduced in pen and ink on the distant receiver. The pencil at the transmitter is fixed at the junction of two jointed rods, which are connected to each of two shafts, and communicate a rotary movement to them. These shafts in turn move contact pieces, which cause a variation of voltage in two electrical circuits. These circuits control two moving coils suspended in an electromagnetic field in the receiver, and the jointed rods connected to these coils actuate the pen which reproduces the writing—or message—on a roll of paper at the receiver.

Thus any motion of the pencil at the transmitter is resolved into two component movements, which cause a variation of the positions of the moving coils at the receiver. These coils, actuating the two levers to which the receiving pen is attached, reproduce the motions of the pencil at the transmitter.

When the paper available for writing on at the transmitter has been used up, it is fed forward mechanically by pulling a lever, which at the same time causes a



Telewriter Transmitter and Receiver arranged with Telephone and Departmental Exchange.

current to be sent through both lines and operates a relay which actuates the paper in the receiver proportionately.

Before starting to send a message, a button is pressed on the transmitter, and this automatically ensures the lever at the receiving end being in the proper position for the instrument to receive a message. The receiving pen—before contact is made by the pencil on the transmitter—reposes in an ink-well, and this ensures that plenty of ink is always obtainable. The telewriter is also fitted with a telephone, and communication can be held by either method over the same lines, but not simultaneously.

An advantage of the telewriter over the telephone is that, should the person rung up be out, the message can be written and will await his return. No operator is necessary to receive the messages, and so long as the roll of paper in the receiver lasts, so long can messages be received.

The ordinary telephone wires are all that is necessary for the operation of the telewriter, the power being

obtained from either batteries or the central station supply. Both direct current and alternating currents can be used, but in the latter case a rectifier must be placed in circuit.

Messages can be sent to practically any number of telewriters from one transmitter, thus assuring the same message being received simultaneously on the various receivers.

The Postmaster-General has granted a licence for twenty-one years to the Telewriter Syndicate, and after 1911, when the National Telephone Company's licence expires, the Telewriter Syndicate will operate its own system and establish telewriter exchanges, paying royalties for the same. These lines will be independent of the Post Office telephones, but will be leased from the Post Office, and telephonic communication in addition is to be a *sine qua non* on all these lines.

At present the telewriter is established chiefly on private lines, and is working satisfactorily in many large warehouses, stores, and offices, but messages and sketches have been successfully sent from London to Manchester over the Post Office telephone trunk lines, which were used, by permission, for the experiment. Arrangements and special instruments are now being made with the view of sending similar messages over the existing trunk telephone line from London to Paris.

SOME ENTOMOLOGICAL PAPERS.

AMONG recent papers on entomology in serials with which we have been favoured, special reference may be made to one by Mr. P. H. Calvert on the dragon-flies (Odonata) of Mexico and Central America, published in the Proceedings of the Academy of Natural Sciences of Philadelphia for October last. This paper, which is mainly based on the article by the same author in the *Biologia Centrali Americana*, forms an important contribution to the study of insect-faunas generally, and treats in great detail of the relationships of the group under consideration. It is assumed—and probably correctly—that the adult insects do not wander far from the haunts of their aquatic larvæ, but until this is definitely ascertained the generalisations, as the author points out, must be regarded as more or less provisional.

To the sixth part of vol. v. of the Annals of the South African Museum Mr. L. Peringuey contributes a seventh instalment of his account of the coleopterous fauna of the country, dealing in this instance with considerably more than one hundred species and several genera described as new. The paper, which is illustrated by two monochrome plates, is of a purely taxonomic character, with the descriptions in Latin.

An addition to our knowledge of the aphides of Japan is furnished by Mr. G. Okajima in vol. viii., No. 1, of the Bulletin of the College of Agriculture of the Imperial University of Tokio. This paper is devoted to the description of three new species of Trichosiphum, a genus founded so recently as 1906 for the reception of another Japanese representative of the group. To the same issue this author contributes a more generally interesting paper, namely, one on the structure of the aphid antennæ. These antennæ are composed of not more than six joints, of which the third and later ones (especially the third) usually bear sensory pits. For their distal portion the name "flagellum" is adopted. It is found that, as regards minor characters, the antennæ present specific differences which harmonise well with the various groups into which the family has been divided.

In a third paper in the serial last cited Mr. T. Miyake gives a list of Japanese Panerpidæ, together with descriptions of ten new species of the type-genus, all of which are illustrated in an accompanying plate. All the new species, which display the general type of colouring characteristic of these elegant insects, agree with the other Japanese members of the group in regard to a peculiarity in one part of the wing-venation.

Under the title of *Indian Forest Memoirs*, the Government of India has commenced the issue of a new quarto serial, intended for the publication of the more important results of the investigations of the Imperial Forest Research Institute. The publication of *Indian Forest Records* is to be continued for minor papers, and the two serials are to constitute the Forest Zoology Series. The first part of the Memoirs is devoted to an account, by Mr. E. P. Stebbing, of some undescribed Scolytidæ of economic importance from the Indian region. Until recently, very little was known with regard to the Indian representatives of this group of bark-boring beetles, and scarcely anything of their life-histories and food-plants. It is now ascertained that the Scolytidæ are of very considerable importance to the Indian forester, this being specially the case as regards the great coniferous forests of the Himalaya. Other species, referable to the genus Sphærotrypes, are, however, detrimental to the sal-forests and other broad-leaved timber-trees. In the present memoir Mr. Stebbing describes three new species of the last-named genus, five of Polygraphus, and two of Dryocetes. Among the species of Sphærotrypes, one, *S. assamensis*, infests the sal-timber of Assam and eastern Bengal, and a second, *S. quercyi*, the oaks of Kumaun.

The Angolese tiger-beetles of the subfamily Cicindelinæ form the subject of an article by Messrs. F. Creighton Wellman and W. Horn in the Proceedings of the Academy of Natural Sciences of Philadelphia for November, 1908. Angola, it appears, is divisible into three distinct physical regions, namely, lowlands, mountainous slopes, and high plateau, the climate of the second of these being cooler and moister than that of the first, although not to the same degree as the third. Each of these areas has its own special tiger-beetle fauna, that of the middle zone possessing the largest number of species.

In this place reference may be made to investigations undertaken in Cornell University by Mr. B. H. Guilbeau, of which the results are published in the *American Naturalist* for December, 1908, as to the mode in which the "cuckoo-spit insects" (Cercopidæ) secrete the foam in which they are enveloped. By cleansing the nymphs from the investing froth, it has been ascertained that the fluid issues from the anal aperture, and is converted into froth by periodical removals of the tip of the abdomen, which is re-introduced holding each time a bubble of air. Viscosity is imparted to the fluid by the secretion of the glands of Batelli.

In conclusion, brief mention may be made of an interesting article, by Mr. A. H. Swinton, on the vocal and instrumental music of insects, the first instalment of which appears in the January number of the *Zoologist*.

THE CHARGES ON IONS.[1]

THE ratio of the charges of ions in liquids to those produced by various methods in gases is a factor that enters into many investigations connected with molecular theories, so that it is of importance that the connection between these charges should be investigated by some accurate method.

The simple relations that hold between the charges of ions in liquids can be easily deduced from the theory of electrolytic conduction. It follows immediately from determinations of the electrochemical equivalents that the charge on any ion in a liquid is either equal to that on a hydrogen atom or an exact multiple of it. No method has been devised for determining this charge directly, but the value of $n \times e$, the product of the number of molecules in a cubic centimetre of a gas at standard pressure and temperature (15° C.) and the charge e expressed in electrostatic unts, is accurately known, and is approximately $1{\cdot}23 \times 10^{10}$.

In gases it is possible to obtain a rough estimate of the charge on an ion. The method of determining the charge, which requires a cloud to be formed in the gas, was given by the present writer (Proc. Camb. Phil. Soc., vol. ix., part v., February, 1897), and was first applied to the ions in newly prepared gases. The same principle was subsequently used by Sir J. J. Thomson and Prof. H. A. Wilson in determining the charges on ions produced by Röntgen rays, ultra-violet light, and radio-active substances (J. J. Thomson, "Conduction of Electricity through Gases"). The numbers obtained for e in electrostatic units range from 3×10^{-10} to 9×10^{-10}, but an

1 Based upon papers by Prof. J. S. Townsend, F.R.S., and Mr. Haselfoot, communicated to the Royal Society January and November, 1908.

accurate estimate of any of the charges has not been obtained owing to the difficulties of experimenting with the clouds. As no trustworthy[1] independent estimates have been made of n, the value of the product $n\times e$ for gaseous ions can only be obtained by this method within wide limits differing by a factor of 10 or 20. It cannot, therefore, be maintained that the direct determination of e in gases leads to any trustworthy information as to the simple relations that hold between the charges on the ions.

A more accurate comparison of the charges on the various kinds of ions can be obtained from determinations of the rate of diffusion of ions in gases and the velocity under an electric force. With this object in view, the rates of diffusion produced by various methods in gases were determined, and it was shown that the value of $n\times e$ for negative ions in gases agreed within 10 per cent. or 15 per cent. with the value for monovalent ions in liquids, and the value for positive ions in gases was somewhat larger (J. S. Townsend, "Diffusion of Ions in Gases," Phil. Trans., vol. cxciii., 1899, and vol. cxcv., 1900). The probable error in the numbers obtained is about 10 per cent. or 12 per cent., so that it is desirable to know more definitely if all these charges are exact multiples of the same atomic quantity, as it is a question of fundamental importance.

The problem of the determination of $n\times e$ for gases has been again undertaken, and a simple experiment has been devised whereby the exact value of $n\times e$ can be immediately deduced from the ratio of the charges acquired by two conductors under special conditions. The method is explained in a paper in the Proceedings of the Royal Society, vol. lxxx., January, 1908, and two papers recently communicated (November, 1908) contain further experiments by the present writer on ions produced by Röntgen rays, and an investigation by Mr. Haselfoot of the ions produced by radio-active substances.

The principle of the method consists in finding the extent to which a uniform stream of ions having a circular cross-sectional area, S, opens out as the ions travel a given distance under a known electromotive force. For this purpose three plates, A, B, and C, are arranged parallel to each other, the middle plate, B, and the lower plate, C, having each a circular aperture cut through its centre. A disc, D, is fixed in the aperture of the plate C, so that the surfaces of the disc and surrounding plate are in the same plane, the disc being a little smaller than aperture in order to insulate it from the plate. The area of the hole S in the middle plate B is equal to the area of the disc *plus* half the air-gap between the disc and the plate C. The plates A and B are connected to suitable numbers of accumulators so as to maintain the same uniform field above and below the middle plate B. The plate C and disc D are insulated, and each maintained at zero potential by a special form of induction balance, which gives the charges acquired simultaneously by the disc D and plate C. The gas in the space between A and B is ionised by Röntgen rays or by radio-active substances, and a uniform stream of ions passes through the aperture in the middle plate. The ions travel to the lower plate under the uniform electric field, and the stream opens out by diffusion, so that some of the ions q_1 arrive on the disc D, and the rest q_2 arrive on the plate C. The ratio q_1/q_2 is found accurately by means of the induction balance, and the value of $n\times e$ may be obtained from the ratio. The equation connecting $n\times e$ and the ratio n_1/n_2 is somewhat complicated, and it would be impossible to explain in a short space how the connection between these quantities is found, but it may be stated that a complete solution of the problem can be obtained in a series of Bessel's functions.

The experiments have been made with different forces and pressures, and it has been found that the value of $n\times e$ for negative ions is in all cases within 3 per cent. or 4 per cent. of the value $1{\cdot}23\times10^{10}$; under conditions where the greatest accuracy can be obtained the results are in closer agreement with this number.

For positive ions the value of $n\times e$ depends on the nature of the radiation. With non-penetrating secondary rays from a polished metal surface the value obtained was $1{\cdot}26\times10^{10}$, and for penetrating rays from a tarnished surface, or a surface covered with a thin layer of vaseline, larger values were obtained, the greatest being $2{\cdot}4\times10^{10}$.

Thus the negative ions have always a charge which is exactly equal to the charge on a monovalent ion in a liquid electrolyte, and the positive ions have either a single or a double charge, the number of either kind in a conducting gas depending on the nature of the radiation.

The values of $n\times e$ for positive and negative ions produced by the α and β rays from radio-active substances are both approximately $1{\cdot}23\times10^{10}$.

In addition to the above results, a notable effect of small traces of moisture on the motion of negative ions was observed. When the gas is very dry the negative ions move as if they were very small particles, but when a small amount of moisture is admitted the mass of the negative ion is greatly increased, and obeys the same laws of diffusion as the positive ions. The motion of the positive ions under similar conditions is not affected by the dryness of the gas.

John S. Townsend.

[1] Prof. Perrin has recently announced a new method of determining n, which gives trustworthy results. The number n comes to 3×10^{19} and corresponds to an atomic charge $4{\cdot}1\times10^{-10}$. (Jean Perrin, *Comptes rendus*, October 5, 1908).

METEOROLOGICAL CHARTS OF THE INDIAN OCEAN.[1]

The Indian Ocean is claiming at the present time a large share of the attention of meteorological offices. Recent issues of Nature have contained notices of meteorological charts for this area issued by the Meteorological Department of the Government of India and by the Meteorological Institute of the Netherlands (Nature, vol. lxxviii., pp. 169, 487). The present charts are prepared by the Deutsche Seewarte. In area they exceed considerably those referred to above, for they embrace the region between latitudes 30° N. and 50° S., and longitudes 18° E. (Cape Town) and 158° E. The Australian waters and the eastern margin of the Pacific Ocean are thus included, while special inset charts extend the area northwards to include the Yellow Sea and the Sea of Japan. To deal effectively with the results, a scale of approximately 6 mm. to one degree at the equator has been selected, and in consequence an inconveniently large size of page, viz. 36 inches by 27 inches, has had to be adopted.

The preparation of the results has occupied five years. The meteorological information has been abstracted mainly from the log-books of German vessels, but we are glad to note that, in addition, use has been made of all available published information. The arrangement of the data on the charts, of which there is one for each month, is similar to that adopted on the charts for the Atlantic Ocean issued by the Seewarte. Conspicuous blue wind roses show for each square of 5° the percentage frequency of calms and of winds from each of sixteen directions. The mean wind force for each direction, on the Beaufort scale, is indicated by the number of barbs on the wind arrows. Small but distinct black arrows give the directions of surface currents, with the average and the maximum observed displacement in nautical miles per day. Special attention has been devoted to a critical examination of the current data, and several interesting articles on the subject appear on the backs of the charts. A statement of the number of observations on which each wind and current arrow is based would have been welcomed by students.

In addition, each chart gives the tracks for steam and sailing vessels, the normal paths of hurricanes, the frequency of fog and ice, and the lines of equal magnetic declination. The region of easterly variation is distinguished by a special tint. The text printed over the land areas gives, in addition to the necessary explanations, a brief summary of the weather conditions of each month, with special reference to the frequency of hurricanes.

On the back of each chart we find four smaller maps, giving the annual change of magnetic variation, the average air temperature over sea and land, the average temperature of the surface water, and the average barometric pressure. In connection with the latter, we miss

[1] Deutsche Seewarte, Monatskarten für den indischen Ozean. (Hamburg Eckardt und Messtorff, n.d.)

an account of the diurnal variation of pressure, which is so important in the tropics. The only reference to this phenomenon is contained, incidentally, in an article on rules for handling the ship in hurricanes, given on the back of the chart for December.

The remaining space on the backs of the charts is utilised to the full. On several of them detailed information is given of the systems of storm signals used in the area covered by the charts. Others give particulars of the time-signal stations. Numerous fully illustrated articles give particulars of meteorological events of special interest, such as the Hong Kong typhoon of September 18, 1906, and other famous hurricanes. In addition, we have a number of monographs on all manner of subjects of interest to the sailor and the meteorologist. Among them we mention specially one on the prevalence of easterly winds to the south of latitude 50° S.

We congratulate the Seewarte on the completion of so important and arduous a piece of work, which is sure to prove of the utmost value both to sailors and students.

THE FILTRATION AND PURIFICATION OF WATER FOR PUBLIC SUPPLY.[1]

GREAT progress has been made in recent times in the appliances for purifying water. It is no longer necessary to go to distant uplands for a pure and palatable supply. By the methods of treating ordinary river water, carrying possibly hundreds of objectionable germs per c.c., drinking water is now being prepared from the lower reaches of the Thames and of many Continental rivers as wholesome as can be obtained from the mountains of Wales or of Scotland. So great has been the activity of scientific workers in this field that a new and complex branch of technology may be said to have come into existence.

With reference to sources of supply, water companies should not place too much reliance on the innocuousness of supplies drawn from country districts. Water-courses and reservoirs should be protected from the intrusion of harmful matters, and the adjacent ground should be fenced off and planted. Special precautions are needful for preventing the ingress of impurities to wells and bore-holes, and where pollution occurs the origin of the same may be detected by suitable experiments. Storage reservoirs are a useful adjunct to a purifying plant, even when not required for conserving the supply, and it has been proved by the researches of Dr. Houston that the bacteria of enteric practically all disappear from impounded water in two or three days. Still, as it appears that even here the survival of the fittest holds good, and that a few germs live on for weeks, water undertakers are not relieved from the duty of further treating the supply. Sedimentation proceeds more or less rapidly in stagnant reservoirs, but it has been found at the Paris installations that effective precipitation can be secured by running the water in channels, with frequent changes of direction. Thus space is economised.

Discussing the retention of bacteria in filter beds, the lecturer directed particular attention to the functions of the filtering skin. It appears that in the finishing filter at Bedford, which is fed by a sprinkler, no skin is formed at the surface, because the water does not rest there. It sinks at once into the sand, and at a depth of about an inch and a half a slimy growth is easily perceptible on the grains, and this possibly serves the same purpose as the network of algoid growths bedecking the open sand beds. There are five distinct ways in which the sand bed operates in eliminating impurities, but what is most important in the operation of these beds is the circumstance that, after cleaning, a considerable time must elapse before the purifying agencies come into effective action. Water managers should have the means of finding out when the effluent is pure, and in order to do this they must rely on bacteriological analyses. This is the method adopted on the Continent. Unfortunately, it is generally neglected here, and it is a matter of chance in too many cases whether there may or may not be dangerous germs passing through. Chemical analyses alone cannot reveal whether the filtrate is wholesome or not. The amount of nitrogen present as nitrate and nitrite is important enough, but analysts should not rely on this as the chief criterion for determining the purity of a sample.

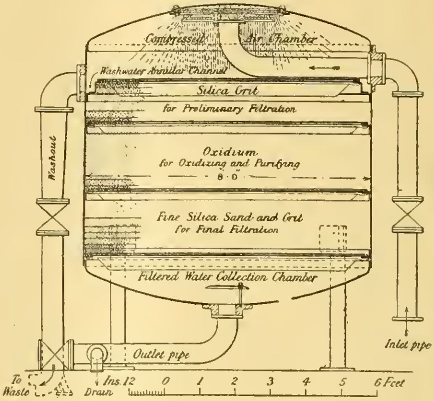


FIG. 1.—Compressed Air and Oxidising Waterworks Filter (Candy).

Recently many mechanical appliances have been brought into use for the purification of water, and among these the Jewell filter is largely used in America. A precipitate of sulphate of alumina forms an efficient skin within a short time after cleaning, and thus there is a great saving of time. The water also passes through the filtering layers forty times more quickly than it does in the open sand filter, but the effluent, subjected to every test, proves to be of a high degree of purity. In Britain, Mather and Platt's and Bell's filters are of similar construction, and

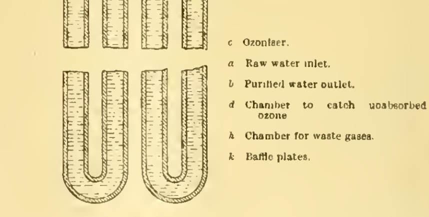


FIG. 2.—Sketch of Ozonising Apparatus (Howard-Bridge) Scale about 1/40. Action of the Apparatus:—As the raw water passes down the pipe *a* it draws the unabsorbed ozone by way of the tube *p* from the chamber *d*. Freshly ozonised air is also drawn into the current from the ozoniser through the pipe *n*. After traversing the vertical pipes, the water is caused to pass round a series of baffle plates *k*, and finally flowing under the recess at *d* it reaches the outlet.

[1] Abstract of a paper by Mr. John Don selected by the Council of the Institution of Mechanical Engineers for the first award of the "Water Arbitration Prize," 1908, and read before the Institution on January 15.

have like advantages. Very fine work is done by the Candy filter, which dispenses with precipitants, and owes its efficiency to oxidium, a substance with properties akin to those of spongy platinum. Cheapness in working is a feature of this installation (Fig. 1), and the effluent is certified by the highest authority to be excellent.

Great interest has been taken of late in the ozone purification processes, which are in operation at Wiesbaden, Nice, Philadelphia, and elsewhere. The chief difficulty in the meantime is to reduce the cost of working to something approaching the outlay for mechanical filtration by other means. Of the efficiency of ozone treatment there can be no question. The bacteria are practically eradicated. The filtrate is sparkling and palatable, even when the raw water is very bad. Progress has been made in reducing costs, and in particular the Howard-Bridge system effects a saving by collecting the unused ozone (see Fig. 2, d) and returning it to the incoming stream.

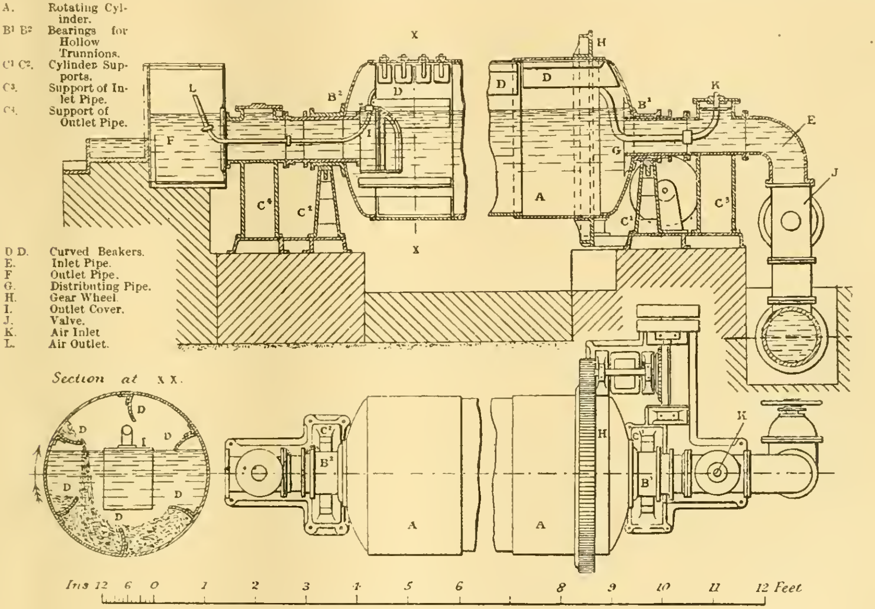


FIG. 3.—Rotating Cylinder containing fragments of Iron (Anderson).

Many appliances are being tested at Paris for the purification of river water, and notable results are being obtained from the Anderson system. The precipitant in this case is iron oxide. So much as 3 grams per cubic metre is taken up by the raw water in traversing cylinders charged with scrap iron, and the oxide serves to precipitate fine silt and plankton, and finally to form a filtering *couche* on the sand beds (Fig. 3). It is here that the sedimentation by tortuous movements, and by conducting the flow over and under baffles, has been found to give such admirable results.

Another remarkable system which is doing good work in the *banlieue* of Paris is the Puech-Chabal. Here the raw water is first passed through the roughing filters, *dégrossisseurs*, so called, in which it leaves a large part of the suspended matters. The *dégrossisseurs* are composed of grits and pebbles graded from about walnut size to gravel in the last of the series. The rough filtration enables the finishing filter to continue in operation for a much longer period, and there is considerable saving of space and of working expenses.

A necessary adjunct to all filtering appliances is a regulator to control the speed of the flow. Filters in which precipitants are employed also require a regulator for adjusting the dosage to the amount of water passing, and various attempts have been made to perfect an appliance for this end. Variations in the state of the raw water have also to be considered.

In the course of distribution of the filtered water to consumers, impurities creep into the mains and service pipes, the chief being iron oxide and filaments of crenothrix, and in special cases lead and its compounds; but by suitable means all these can be eliminated, and without much outlay. On the whole, the application of scientific method and research to the technicalities of water purification have brought about many valuable improvements, and it may be expected that the future has much in store for the water engineer.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following have been nominated to serve, for eight years from February 20, on the board of electors to the professorship mentioned before their names:—*Chemistry*, Prof. Wood; *Plumian*, Mr. Mollison; *Anatomy*, Dr. Langley; *Botany*, Prof. I. B. Balfour; *Geology*, Dr. A. S. Woodward; *Jacksonian*, Prof. Larmor; *Medicine (Downing)*, Dr. Fletcher; *Mineralogy*, Dr. Marr; *Political Economy*, Dr. Marshall; *Zoology and Comparative Anatomy*, Mr. F. Darwin; *Experimental Physics*, Sir W. D. Niven; *Mechanism and Applied Sciences*, Dr. Forsyth; *Physiology*, Prof. Starling; *Surgery*, Dr. Gaskell; *Pathology*, Sir T. Clifford Allbutt; and *Agriculture (Drapers)*, Prof. Biffen.

Mr. J. B. Peace, of Emmanuel College, has been appointed chairman of examiners for the mechanical sciences tripos, 1909.

Dr. W. H. R. Rivers, of St. John's College, has been nominated to represent the University on the occasion of the celebration in July of the fiftieth aniversary of the foundation of the Anthropological Society of Paris.

Dr. T. G. Longstaff will deliver a lecture in Cambridge on Friday, February 12, on his explorations in the Himalayas. A lecture will be delivered in the Sedgwick Museum at 5 p.m. on Tuesday, February 23, by Dr. Agnes S. Lewis, "On some Deserts that I have Crossed." Dr. Sven Hedin will deliver a lecture before the University on Thursday, March 4.

With the object of encouraging original research in sanitary science, the Grocers' Company offers two scholarships, each of 300*l.* a year, with an allowance to meet the cost of apparatus and other expenses in connection with the work, tenable for one year, but renewable for a second or third year, subject to the conditions of the scheme under which they are established. The next election will take place in May. Applications must be sent in before April 1 to the clerk of the Grocers' Company, Grocers' Hall, London, E.C., from whom a form of application and further information may be obtained.

The observatory syndicate has reported that, following closely on the generous gift of the Huggins instruments by the Royal Society, another offer of valuable spectroscopic instruments has been made to the astrophysical department of the observatory by Major E. H. Hills, C.M.G., R.E. Among the instruments are a four-prism quartz spectroscope with 5-inch quartz objective, a two-prism dense flint spectroscope with 4½-inch Cooke achromatic objective, and a heliostat with 12-inch flat mirror by the late Dr. Common.

Manchester.—Dr. W. H. Lang has been appointed Barker professor in cryptogamic botany, and Dr. Marie C. Stopes has been appointed, for one year, special lecturer in palæobotany.

A recent number of *Science* announces the following benefactions to higher education in the United States. Gifts to the amount of 69,300*l.* to Princeton University, of which the largest, 40,000*l.*, was that of Messrs. David B. Jones and Thomas D. Jones, of Chicago, for the Palmer Physical Laboratory endowment fund. Other donatinns were 5100*l.* from the committee of fifty and 7000*l.* from the General Education Board. More than 8000*l.* has been subscribed towards a fund of 20,000*l.* to endow a chair of physiology at the University of Cincinnati, in honour of the late Mr. Joseph Eichberg. President John Thomas, of Middlebury College, states that 18,300*l.* has been contributed toward the 20,000*l.* needed to secure the D. K. Pearson building and endowment fund of 20,000*l.* By the will of Dr. James G. Wheeler, Broughton, the James Millikin University, Decatur, will come into possession of his estate, estimated to be worth from 15,000*l.* to 25,000*l.* The Ohio State University has received 2000*l.* from Mr. Robert T. Scott, Cadiz, the income to be used for the aid of poor students. From the same source we learn that Mr. John D. Rockefeller has made a further gift of 250,000*l.* to the University of Chicago. His gifts to the University now amount to more than 5,000,000*l.* At the last meeting of the board of directors of Bryn Mawr College a gift of 20,000*l.* was presented to the board by the Alumnæ Association of the college, the first instalment of the sum of 200,000*l.* which the alumnæ have undertaken to try to raise for the additional endowment of the college. The alumnæ have made it a condition of their gift that the money shall be used for academic salaries, and they have endowed the chair of mathematics with this first 20,000*l.*, and stipulated that the money released by freeing the college from maintaining this professorship shall be used in raising the salary of each full professor in the college.

The annual prize distribution of the Northampton Polytechnic Institute was held on Friday, February 5, when the prizes were distributed by the Earl of Halsbury, P.C. In the course of his address Lord Halsbury dealt very fully with certain aspects of technical education, particularly with the progress made during the six years since he last officiated at the Northampton Polytechnic Institute in a similar capacity. It appeared to him that the world is somewhat more awake now than it was some time ago, not only in this country, but in other countries, and that people are beginning to think that unless they are to be outstripped in the battle of the industries they must look to themselves and consider in these battles, as well as in battles of another sort, that the people who sleep on what they have got are very likely to lose it, and that we in England are in danger of being left behind in the race. The need for high scientific training was emphasised by reference to the discovery of the part played by fleas on rats in the dissemination of disease, and the "Ca Canny" principle was severely condemned. The liberality of the County Council towards the institute was suitably emphasised in connection with the new buildings which were opened during the evening. The need of such institutes in view of the decadence of the system of apprenticeship was emphasised very strongly. At the end of his speech Lord Halsbury, as Prime Warden of the Saddlers' Company, announced that the company has entrusted the Northampton Institute with certain bursaries to be applied by the institute to those students in training who require such assistance, the bursaries being specially intended to assist the students in their work in the workshops during their four years' training in the day engineering courses. At the conclusion of the prize giving, Lord Halsbury proceeded to the new building, which has been erected at a cost of 9000*l.*, the funds being provided by the London County Council. In the large lecture-room of these buildings they were declared open. On the Friday evening and on the following evening some 6000 visitors inspected the institute.

The annual general meeting of the Association of Technical Institutions was held at Grocers' Hall, London, on February 5 and 6. The business meeting on the first day was preceded by a luncheon, at which members of the association were entertained by the Grocers' Company. In proposing the toast of "The Association of Technical Institutions," Sir William White said he does not believe in the truth of the statements as to the decadence of England, but he is sure that if we are to keep the position we hold we must as a nation lose no opportunity of developing the technical institutions of the country. Sir Norman Lockyer responded, and during the course of his remarks said if Mr. Haldane had gone to the Education Office instead of the War Office, we should have had a Board of Education responsible for all education from top to bottom, instead of the truncated body we have at present. There would be a general staff, full of knowledge, directing everything, so that in a few years' time by this organisation and the administrative conditions it brought about we should have such a peace army as Mr. Haldane is endeavouring to give in the shape of a war army. At the subsequent meeting Dr. George T. Beilby, F.R.S., was elected president for 1909, and proceeded to deliver his address. If, he said, the members of the association are possessed by the belief that the industrial future of the nation must largely depend on the spread of education in science and in the application of its laws to the affairs of daily life, then they cannot escape from the conclusion that it is their particular duty to see to it that they are taking a leading part in this vitally important work. If, he pointed out, the training in technical institutions is to be modelled on the lines of the best professional standards, it is necessary to secure the active cooperation of representative men from those industries for which it is proposed to train the students. With the help of such representatives courses of instruction, practical as well as theoretical, must be organised. The same kind of reality must be given to the practical side of the work as is found in the clinical teaching of medical students, and it must be made compulsory for all who desire to obtain the full diploma of the college. On the second day Principal F. C. Forth, of Belfast, read a paper on the management of the entrance examinations giving admission to the evening classes of a technical institute, and Mr. Sidney Webb opened a discussion on compulsory attendance at evening classes.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 10, 1908.—"Potential Gradient in Glow Discharges from a Point to a Plane." By J. W. **Bispham.** Communicated by Sir J. J. Thomson, F.R.S.

Three types of discharge were examined; for very small currents (type A) the glow was limited to the immediate neighbourhood of the point. For larger currents (type B) the luminous glow spread out in a conical form from point to plate, and the current, as indicated by a telephone in circuit, became intermittent. The oscillations of current amplitude could be augmented and decreased in frequency by capacity and inductance, and striæ then began to appear. The striæ were absolutely steady to the eye, in spite of the intermittent nature of the current. When the current was still further increased the flow became continuous, and the glow (type C) was limited to the neighbourhood of the axis of discharge. In this condition the point appeared to be exerting no peculiar effect—the discharge was simply that between two small electrodes.

An exploring electrode was inserted between the point and the plane, and by means of flotation on mercury it could be made to take up any position on the axis relative to the point and plane. The electrode took up the potential of the gas, and in this way potential curves were obtained and the electric force at various points calculated from them.

Electric-force curves were obtained for the A type which indicated that it only possessed a limited range of stability, not being obtained at all for pressures less than 11·3 mm. (point negative) and 3 mm. (point positive) in discharges in hydrogen. Current increase led to the production of the B type of discharge. For the B type of discharge it was observed that the kathode dark space was abnormally large, and also that the kathode glow was a doublet consisting of two bright layers separated by a layer of very low luminosity.

Apparent reversals of field were observed near the electrodes, but it was found that these apparent reversals varied with the capacity of the electroscope used to measure the potential, and they were interpreted to indicate local excesses of positive and negative electrification rather than reversals of field. The distortion of the potential curve was increased by increasing the capacity of the electroscope. No distortion was observed in the case of the C type of discharge, and the capacity of the electroscope did not affect the readings. Evidently the distortion of the curve was to be associated with the intermittent character of the discharge in type B.

It was concluded (for type B) that the Crookes dark space was positively electrified, while negative ions were in excess at a point further away from the kathode. Similarly, when striæ were obtained the anode side of a stria was positively electrified, while the kathode side was negatively electrified, as indicated by the potential curves. In the C type of discharge a constant and normal kathode fall was obtained for wide ranges of pressure and current variation, and the curves were of the same type as has been obtained by Prof. H. A. Wilson for discharges between small plane electrodes. They afforded testimony as to the efficient working of the explorer. In this type of discharge, also, the kathode dark space was observed to be unusually large, and the negative glow resembled rather a large stria embedded in a pale blue halo. Some of the curves obtained for the point glow (A type of discharge) indicated that the discharge proceeded in two stages, a discharge from the point to the neighbouring gas, succeeded by a discharge from this gas to the plate.

Royal Microscopical Society, January 20.—Anniversary meeting.—Lord Avebury, F.R.S., president, in the chair.—Presidential address, entitled "On Seeds, with Special Reference to British Plants": Lord **Avebury.** In this the president more particularly dealt with the seeds of gymnosperms and monocotyledons, in continuation of the address of the previous year, in which the seeds of dicotyledons were considered.

Physical Society, January 22.—Dr. C. Chree, F.R.S., president, in the chair.—Effective resistance and inductance of a concentric main, and methods of computing the Ber and Bei and allied functions: Dr. A. **Russell.** The following simple formula for the effective resistance R, per centimetre length, of the inner conductor of a concentric main for high-frequency currents is obtained:—

$$R = (\rho m/2\pi a)(0{\cdot}7071 + 1/2ma + 0{\cdot}265/m^2a^2 - 0{\cdot}35/m^4a^4),$$

where ρ is the volume resistivity of the conductor, a its radius, $m^2 = 8\pi^2\mu f/\rho$, μ the permeability of the conductor, and f the frequency of the alternating current. This formula may be used in wireless telegraphy for calculating the resistance of a conductor when other conductors carrying high-frequency currents are not too close. For values of ma greater than 6 the maximum inaccuracy of the formula is less than 1 in 10,000. In obtaining the solution, exact formulæ are obtained for the density of the current at all points on the inner and outer conductors.—Note on the luminous efficiency of a black body: Dr. C. V. **Drysdale.** The importance of efficient methods of light production renders it of interest to ascertain the possibilities of a black body as a light radiator at various temperatures, and the author has attempted to obtain these from the radiation formula of Wien. The energy radiated between any two wave-lengths is written down, and the total radiation calculated. This, in conjunction with Kurlbaum's determination of the radiation constant, and Lummer and Pringsheim's results, gives rise to the formulæ given in the paper. A table and curves calculated from these formulæ have been worked out by Mr. A. F. Burgess, and show the relation of the total and luminous radiation and luminous efficiency for various temperatures. The comparison of the luminous energy so calculated with the intensity of light radiation found by Prof. Féry leads to a mechanical equivalent of light of about 0·075 watt per candle, which is a fairly probable figure. The results show the enormous extent to which the luminous efficiency is dependent upon the temperature, and how extremely low it is at ordinary temperatures. At 1500° C. the efficiency is only of the order of 1 per cent. or less, while at 2000° C. it is about 3 per cent. The highest efficiency is obtained at a temperature of about 6500° C., and is then only between 40 per cent. and 50 per cent. This strongly points to the necessity for working in the direction of selective radiation or luminescence.—The use of the potentiometer on alternate current circuits: Dr. C. V. **Drysdale.** The great difficulty in alternate current measurement lies in the shortness of the range of the instruments available, and there is therefore a great need for some instrument which, like the direct potentiometer, should be capable of measuring P.Ds. and currents of any range with accuracy. By interposing an ammeter on the dynamometer principle in the main circuit of a potentiometer and deriving the current from the secondary of a phase-shifting transformer, it is possible to check the instrument with direct current against the standard cell in the ordinary way, and then to reproduce the same current in the potentiometer circuit and to bring it into coincidence of phase with the P.D. to be measured. Experiments have been made with this device by Mr. A. C. Jolley and the author, first as to the accuracy of current measurement using an ordinary low-resistance standard, and have been found to give very good agreement with a Kelvin balance. Other tests have been made to obtain the vector difference of potential across a resistance coil and a choking coil connected in series, and the triangle of voltages so formed was found to be very nearly closed. The tests so far made seem to indicate that an alternate current P.D. of 0·1 volt can be measured to an accuracy of 0·2 per cent. or closer. The author has also designed a universal potentiometer on this principle which serves both for direct- and alternate-current measurements, and for testing P.D., current, phase, power, inductance, capacity, &c.

Royal Anthropological Institute, January 26.—Annual general meeting.—Prof. W. Ridgeway, president, in the chair.—Anniversary address, the relation of anthropology to classical studies: Prof. **Ridgeway.** The results that had followed from the use of the anthropological method in the study of the classics were pointed out. Subjects which had long been obscure or had given rise to wild speculations, in the light of anthropology took upon themselves a clear meaning. For example, Aristotle's account of the origins of Greek society, an account which had for long

perplexed scholars, can be explained by comparing it with institutions still surviving amongst primitive peoples; but it is only of recent years that any such comparison has been made, or such an explanation given. It is not only in the domain of sociology or religion that such a comparative method is of service. The art of the Greeks, for example, can be shown to have been at one time in a stage comparable to that of the modern savage, from which it has directly developed. Again, a knowledge of anthropology will be of great service to an intelligent understanding of classical literature. The attacks which have been made on classical studies, and especially on the teaching of Greek, are in great measure due to the classical scholars themselves, who by their pedantry and indifference to scientific method have caused the reaction which has set in against these studies.

Mineralogical Society, January 26.—Dr. A. E. H. Tutton, F.R.S., vice-president, in the chair.—The identity of poonahlite with mesolite: Dr. H. L. **Bowman.** Small colourless prisms, associated with stilbite and pale green apophyllite from Poonah, which appear to be identical with the mineral described by H. J. Brooke in 1831 as poonahlite, are shown by analysis to be mesolite, having a composition corresponding to a mixture of two molecules of scolecite with one of natrolite. The optical characters are similar to those recently observed by Görgay in mesolite from the Faroe Islands.—Cross-planes in twin-crystals: Dr. J. W. **Evans.** A twin-plane is composed of two equivalent planes, one from each component crystal, and every line in it is composed of two equivalent lines. A cross-plane is also composed of two equivalent planes, but there are only two, four, or six lines (at right angles in pairs) composed of equivalent lines. A plane of composition is always a twin-plane or a cross-plane. In the former molecular distances are the same in all directions in the plane, in the latter in two, four, or six directions only.—Comparison of the refractive indices of adjoining crystals in a rock slice which have their directions of vibration oblique to one another: Dr. J. W. **Evans.** The Nicols are placed with their directions of vibration parallel and bisecting the angle θ between the directions of the vibrations the refractive indices of which are to be compared. The light received from these directions will (apart from interference) be proportional to $\cos^2\theta/2$, and that from those at right angles to them $\sin^2\theta/2$, so that the former will bear to the latter the ratio $\cot^2\theta/2$. If θ be less than 35° this will be greater than ten, and the light from the directions at right angles may be neglected both in respect of its direct effects on the Becke phenomena and its indirect action in producing interference.—Note on the spontaneous crystallisation of solutions as spherulites: J. **Chevalier.** Experiments on solutions of potash-alum, sodium, ammonium and lithium sulphates, &c., made at the suggestion of Prof. Miers in the Oxford Mineralogical Laboratory, show that spherulites and sphero-crystals are characteristic of the spontaneous crystallisation of many solutions in thin drops. When other crystals grow first, it is probably because they have been introduced, the drop in that case appearing to be metastable. The spherulites mark the passage of the solution to the labile state.—A method for studying the optical properties of crystals: the late Dr. H. C. **Sorby.** The author gives complete details of his work on the determination of refractive indices in thin plates, of which preliminary accounts have been published in the first two volumes of the *Mineralogical Magazine*. The method he describes in the case of doubly refractive minerals is identical in principle (though devised quite independently) with that given by the Duc de Chaulnes for singly refractive substances, but is worked out in far greater detail. Some additional localities for idocrase in Cornwall: G. **Barrow** and H. H. **Thomas.** During the mapping of the metamorphic area round the Bodmin Moor granite, further occurrences of idocrase have been found in the altered limestones. Well-shaped crystals of the mineral, up to 6 mm. in length, are fairly common in drusy cavities. They are perfectly uniaxial, but show in thin sections considerable variation in the double refraction, especially in the outer layers of the crystals. The idocrase is associated with pale pink to pinkish-brown garnet (often in regular intergrowth with the idocrase), pale green diopside, and epidote approximating to clinozoisite in its low extinction and birefringence.—Detrital andalusite in Tertiary and Post-Tertiary sands: H. H. **Thomas.** Occurrences of detrital andalusite are described in sands from various localities in West Wales. In no sedimentary rock of greater antiquity than the Pliocene has detrital andalusite been found. In the sands of West Wales the mineral occurs as slightly elongated, somewhat angular grains, often showing very intense pleochroism from blood-red to pale greenish-blue. It is associated in these sands with pink garnet, greenish-brown augite, cyanite, zircon, rutile, tabular anatase, staurolite, brown and more rarely blue tourmaline, green hornblende, bright green epidote, cordierite, iron ores, and in some cases glaucophane.—The energy of twin-crystals: H. **Hilton.** The author determines in a simple case the conditions according to which a twin-crystal may be a more stable form, or, in other words, may have less surface energy than a simple crystal of the same volume.

Geological Society, January 27.—Prof. W. J. Sollas, F.R.S., president, in the chair.—The Conway succession: Dr. Gertrude L. **Elles.** In this area the author found a complete succession of strata, from Llandeilian up to Salopian date. A table of the divisions proposed is given. The beds are described in ascending order, lists of fossils being given from the more important exposures. There is no break in the sequence between the Ordovician and the Silurian rocks in the district. A detailed comparison is established between the rocks of this area and those of South Wales, the Rhayader and Tarannon districts, Lakeland, the south of Scotland, and Pomeroy. The Conway Mountain volcanic series appears to be equivalent to the Borrowdale volcanic rocks of the Lake District, and the Cadnant Slates and Bodeidda Mudstones equivalent to the Upper Dicranograptus Shales, Trinucleus beds, and Sholeshook Limestone of South Wales, the Sleddale and Roman Fell groups of Lakeland, and the Upper Glenkiln and Lower Hartfell of the south of Scotland. The Deganwy Mudstones are paralleled with the Redhill beds and the Ashgill Shales. Close comparison is possible between the graptolitic zones of the Gyffin Shales and corresponding beds at Rhayader, Tarannon, in the Lake District, and the south of Scotland.—The depth and succession of the Bovey deposits: A. J. **Jukes-Browne.** The total thickness of the Tertiary beds in the Bovey basin has never yet been ascertained. Some years ago a boring, which reached a depth of 526 feet from the surface, was put down. Particulars concerning the beds traversed by this boring have led to a discussion of the succession of the Bovey deposits, so far as they have been explored. A generalised description of the strata seen in the Heathfield pit, and penetrated by the boring from the bottom of that excavation, is given. The conclusion arrived at by Pengelly in 1861 with regard to the relative age of the beds exposed in the "old coal-pit" south-east of Bovey Tracey, and those proved in a boring to the east of it, is confirmed. The total thickness of the "Eocene" beds is estimated to be about 613 feet. The Bovey basin itself is regarded as a tectonic basin or post-Eocene pericline, and not as a lake-basin. Heer's view of the manner in which the lignites were formed is dissented from, and the identification of some of the plants discussed, and it is concluded that the lignites, which form the mass of the lower beds, represent the growth and decay of successive swamp-forests. Assuming these lower beds to be of Eocene age, and contemporaneous with the Bournemouth beds of the Hampshire basin, it is pointed out that nothing has yet been proved with regard to the higher beds, which may be of Bartonian or even of Oligocene age.

MANCHESTER.

Literary and Philosophical Society, January 26.—Prof. H. B. Dixon, F.R.S., president, in the chair.—The dowels of some Egyptian coffins of the twelfth dynasty: T. G. B. **Osborn.** An examination was made of various wooden coffins of the twelfth dynasty in the Manchester Museum, using microscopic methods with the view of determining the timber employed in their construction. The wood used in making the body of the coffins was found to be sycamore (*Ficus sycomorus*), while the dowels or wooden pins, with

which they were joined, were of acacia, a harder and tougher wood.—The diatomaceous deposit of the Lower Bann Valley, N. Ireland, and prehistoric implements found therein: J. W. **Jackson.** The diatom deposit occupies a considerable area on both sides of the river Bann, and varies in thickness from 6 feet at Culbane to 18 inches near Lough Beg. At Toome and the Ferry near Lough Beg the clay is cut out in brick form, dried, milled, and put up in sacks for export. The prepared material, known as "Kieselguhr," is used in about fifty manufactures as varied as "polishing powder," "filtering material," "insulating medium," and "tooth and face powders." The prehistoric implements found in working the clay were collected by the late Mr. R. D. Darbishire and Mr. Bell, of Belfast. They comprise large numbers of worked flint flakes, viz. knives, borers, and scrapers, a few flint celts and arrowheads, a number of implements made of coarse clay-slate, and several others. Other objects described were grindstones, found near Culbane; clay-slate whetstones, one being of peculiar interest from bearing on its face a number of rune-like characters, possibly inscribed thereon to convey a message; and a large saddle-quern, weighing 62 lb., also found at Culbane. Some Oghamic scribings from other parts were referred to. The tools probably range from the Neolithic to the Bronze age.

Dublin.

Royal Irish Academy, January 25.—Dr. F A. Tarleton, president, in the chair.—The Irish horse and its early history: Dr. R. F. **Scharff.** That the modern Irish horse shows remarkable traces of an eastern strain is well known, and has been alluded to by many writers. This is currently believed to be due to human introduction of Spanish horses possessing eastern characteristics. Prof. Ridgeway contended that a superior class of horses resembling the Libyan race had been sent to Ireland even since pre-Christian times. The author exhibited Irish horse remains from crannogs, bogs, marls, and caves, and showed that all these were quite as Arab-like as any modern Irish horse, even more so. He expressed the view that, as some of these bones belonged to wild horses, the eastern features in the modern races were not altogether the result of artificial introduction, but due to inheritance from the original wild stock of the country.—A supplementary list of the spiders of Ireland: Denis R. **Pack-Beresford.** The list contains the record of fifty-eight species of spiders taken in Ireland since the publication of Prof. Carpenter's "List of the Spiders of Ireland" in 1898. Only one species *Lophocarenum stramineum*, Menge—has not yet occurred in Great Britain, though it has been taken in two localities in the south of Ireland. A single specimen of the rare *Eugnatha striata*, L. Koch, is recorded from Sligo, and *Gongylidiellum paganum*, Sim., *Lophomma stativorum*, Sim., and *Wideria melanocephala*, Camb., have been taken in Co. Carlow, having only previously been found in single localities in England. An exotic species—*Triaeris stenaspis*, Sim.—a native of Venezuela, has been taken in the Botanic Gardens, Glasnevin, in the hot-houses. A second list contains a few corrections in nomenclature of species in Prof. Carpenter's list, and a third gives all the records available at present of new localities for some of the rarer species inhabiting Ireland.—Contributions towards a monograph of the British and Irish Oligochæta: R. **Southern.** Ten new species were described, and twenty-one additions to the fauna of the British Isles were recorded. The total number of species and subspecies now known to occur in the British Isles is 135. A consideration of the distribution of the Irish earthworms leads to the conclusion that the Lusitanian species, at least, are part of a pre-Glacial fauna. This is opposed to the "glacial" theory advanced by Prof. Michaelsen to explain the present distribution of the Lumbricidæ.

Paris.

Academy of Sciences, February 1.—M. Bouchard in the chair.—The diffusion of saline manures in the soil: A. **Muntz** and H. **Gaudechon.** A patch of soil containing a salt such as potassium chloride or nitrate attracts moisture from the surrounding earth, giving a damp patch. This explains why it is not advisable to use such manures at the time the seeds are planted, since if the seed is in a saline patch it is killed by the strong solution, and outside such a patch the soil is rendered too dry for germination. Even in moist soils diffusion of the salt horizontally takes place with extreme slowness.—A fructification of a Lycopodinium found in the Trias: P. **Fliche.**—Results of micrometric measurements made at the Observatory of Lyons during the eclipse of the sun of June 28, 1908: J. **Merlin.**—The comparative activity of the Leonid and Geminid swarms of November 14, 1907: Maurice **Farman** and Em. **Touchet.**—New researches on the selective absorption and diffusion of light in interstellar space: G. A. **Tikhoff.** Photographs of the Pleiades were made through four screens allowing the passage of the ultra-violet, indigo-violet, yellow-green, and orange rays respectively. The proofs thus obtained showed very clearly that, with a few exceptions, the difference of brightness of the brilliant and feeble stars of the Pleiades increases in an unexpected manner in passing from the orange rays to the ultra-violet. The general results are in accordance with the predictions of Prof. Turner in a recent note on the diminution of light in its passage through interstellar space, based on the supposition of the scattering of light by particles disseminated through space.—Families of Lamé composed of Dupin cyclids: A. **Demoulin.**—Some remarks on geodesic lines, with reference to a recent note by M. Drach: M. **Hadamard.**—The integrals of an algebraical differential equation of the first order: Pierre **Boutroux.**—The application of a generalised theorem of Jacobi to the problem of S. Lie-Mayer: W. **Stekloff.**—The approximate representation of continuous functions by a multiple integral: M. **Fréchet.**—The diminution of phosphorescence at low temperatures: J. **de Kowalski.** Various derivatives of benzene cooled to the temperature of liquid air were exposed to the rays of a mercury arc lamp. The phosphorescence was then observed through different screens, and the time during which the light was visible noted. It was found that the diminution of intensity was more rapid with the long wave-lengths than with the short wave-lengths.—Some new reactions of dioxyacetone: G. **Denigès.** A solution containing dioxyacetone, sulphuric acid, and potassium bromide gives definite colour reactions with gallic and salicylic acids and other organic compounds.—The action of air and other oxidising agents on coals: O. **Boudouard.** In contact with air, coals absorb oxygen, especially at high temperatures. Coking coals, oxidised at 100° C., lose their power of coking, and after such treatment contain humic acid.—The formation of hydrocyanic acid in the action of nitric acid on phenols and quinones: A. **Seyewetz** and L. **Poizat.** Hydrocyanic acid is formed by the action of a boiling solution of nitric acid (20 per cent.) on numerous organic compounds, especially those containing a phenolic or quinonic group. This is due to the presence of nitrous acid, since if urea or aniline be present no hydrocyanic acid is formed, and a theory based on this fact is suggested.—The action of nitrosobenzene on the secondary amines: P. **Freundler** and M. **Juillard.**—Some reactions of the 9:10-dihydride of anthracene and of anthranol: R. **Padova.** A condensation product with benzophenone chloride is described.—The combustion of gases without flame and on the conditions of lighting by incandescence: Jean **Meunier.**—The extension of the notion of solubility to colloids: M. **Duclaux.** The ordinary definition of solubility is inapplicable to colloids. If a colloid solution is placed in a vessel permeable to the solvent, the latter will escape through the walls, and the concentration of the colloid will increase up to a certain limit, which defines the solubility at the temperature of the experiment. The classification of colloids is considered from this point of view.—The action of acids on peroxydiastase: Gabriel **Bertrand** and Mlle. M. **Rozenband.**—The maltase of maize: R. **Huerre.** Different species of maize contain maltases differing in their temperatures of maximum activity, and also in the range of temperature over which hydrolysis of starch takes place.—The use of ferrous arseniate against the parasitic insects of plants: MM. **Vermorel** and **Dantony.** This insecticide possesses the advantages of adhering well to the plants, strong insecticidal powers, little or no damage to the plant, and less

dangerous to man than other arsenical compounds previously proposed.—Concerning the anatomy of the human thymus: René **Cruchet.** The results recently published by MM. Henri Rieffel and Jacques Le Mée confirm the results published by the author seven years ago.—New cytological researches on the aseptic autolysis of the liver: L. **Launoy.**—Researches on the contagion of tuberculosis by air: M. **Le Noir** and Jean **Camus.** Experiments made with the air of a hospital ward filled with tuberculous patients showed that while no bacilli could be detected in the air, the dust was infected.—The duration of the hypotensive effects resulting from high-frequency currents: E. **Doumer.** The good effects are in general durable. In cases where there was a tendency to relapse, a very short course of the original treatment was sufficient again to lower the blood pressure.—The immediate and ultimate results of arterio-venous suture: Albert **Frouin.**—The various types of stolon in Syllidians, especially a new species (*Syllis cirropunctata*): Aug. **Michel.**—The evolutive cycles of a Scyphistome: Edgard **Hérouard.**—The existence of coal at Gironcourt-sur-Vraine (Vosges): René **Nicklès.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 11.

ROYAL SOCIETY, at 4.30.—The Nerves of the Atrio-ventricular Bundle: J. Gordon Wilson.—An Experimental Estimation of the Theory of Ancestral Contributions in Heredity: A. D. Darbishire.—On the Determination of a Coefficient by which the Rate of Diffusion of Stain and other Substances into Living Cells can be measured, and by which Bacteria and other Cells may be Differentiated: H. C. Ross.—The Origin and Destiny of Cholesterol in the Animal Organism. Part III., The Absorption of Cholesterol from the Food and its Appearance in the Blood: C. Dorée and J. A. Gardner.—On the Origin and Destiny of Cholesterol in the Animal Organism. Part IV., The Cholesterol Contents of Eggs and Chicks: G. W. Ellis and J. A. Gardner.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Use of Large Gas Engines for Generating Power: L. Andrews and R. Porter.

MATHEMATICAL SOCIETY, at 5.30.—On the Relation between Pfaff's Problem and the Calculus of Variations: Prof. A. C. Dixon.—On Implicit Functions and their Differentials: Dr. W. H. Young.—On a Certain Family of Cubic Surfaces: W. H. Salmon.—Some Fundamental Properties of Lebesgue Integrals in a Two dimensional Domain: Dr. E. W. Hobson.—Modular Invariants of a General System of Linear Forms: Prof. L. E. Dickson.—The Conformal Transformations of a Space of Four Dimensions and the Generalisation of the Lorentz Einstein Principle: H. Bateman and E. Cunningham.—On Indeterminate Forms: Dr. W. H. Young.

FRIDAY, FEBRUARY 12.

ROYAL INSTITUTION, at 9.—The Electrical Properties of Flame: Prof. H. A. Wilson, F.R.S.

PHYSICAL SOCIETY, at 8.—Annual General Meeting.—Presidential Address.

MALACOLOGICAL SOCIETY, at 8.—Annual General Meeting.—Presidential Address: Darwinism and Malacology: B. B. Woodward.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design and Construction of Docks: Sir Whately Eliot.

MONDAY, FEBRUARY 15.

ROYAL SOCIETY OF ARTS, at 8.—Modern Methods of Artificial Illumination: Leon Gaster.

VICTORIA INSTITUTE, at 4.30.—Discoveries in Babylonia and Neighbouring Lands: Dr. T. G. Pinches.

TUESDAY, FEBRUARY 16.

ROYAL INSTITUTION, at 3.—The Architectural and Sculptural Antiquities of India: Prof. A. A. Macdonell.

ZOOLOGICAL SOCIETY, at 8.30.—The Fauna of the Cocos-Keeling Atoll: F. Wood-Jones.—Contributions to the Anatomy of certain Ungulata, including Tapirus, Hyrax, and Antilocapra: F. E. Beddard, F.R.S.—Le Rhinocéros Blanc du Soudan: Prof. E. L. Trouessart.

ROYAL STATISTICAL SOCIETY, at 5.—Forestry in Some of its Economic Aspects: Prof. W. Somerville.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design of Marine Steam-Turbines: S. J. Reed.

ROYAL SOCIETY OF ARTS, at 8.—The Commercial Relations of France and Great Britain: Yves Guyot.

WEDNESDAY, FEBRUARY 17.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On a German Silver Powell Portable Microscope, made in 1850: A. A. C. E. Merlin: The "Red Snow" Plant, *Sphaerella nivalis*: G. S. West.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report on the Phenological Observations for 1908: E. Mawley.—The Cold Spell at the End of December, 1908: W. Marriott.

THURSDAY, FEBRUARY 18.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Osmotic Pressures of Calcium Ferrocyanide Solutions, Part II., Weak Solutions: Earl of Berkeley, F.R.S., E. G. J. Hartley and J. Stephenson.—On the Spontaneous Crystallisation of Monochloracetic Acid and its Mixtures with Naphthalene: Prof. H. A. Miers, F.R.S., and Miss F. Isaac.—An Apparatus for Measurements of the Defining Power of Objectives: J. de G. Hunter.—On Best Conditions for Photographic Enlargement of Small Solid Objects: A. Mallock, F.R.S.

ROYAL INSTITUTION, at 3.—Problems of Geographical Distribution in Mexico: Dr. Hans Gadow, F.R.S.

LINNEAN SOCIETY, at 8.—Discussion on Alternation of Generations: opened by Dr. W. H. Lang.

FRIDAY, FEBRUARY 19.

ROYAL INSTITUTION, at 9.—Recent Advances in Means of Saving Life in Coal Mines: Sir Henry Cunynghame, K.C.B.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting.—*Further discussion*: The Filtration and Purification of Water for Public Supply: John Don.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Standardisation in Engineering Practice: Dr. W. C. Unwin, F.R.S.

CONTENTS.

THURSDAY, FEBRUARY 18, 1909.

APPLIED PHYSIOLOGY OF THE CIRCULATION.

Therapeutics of the Circulation: Eight Lectures delivered in the Spring of 1905 *in the Physiological Laboratory of the University of London.* By Sir Lauder Brunton, Bart., F.R.S. Pp. xii+272. (London: John Murray, 1908.) Price 7*s*. 6*d*. net.

PERHAPS there is no department of the healing art in which the vivifying and reconstructing influence of physiology and of laboratory methods is more apparent than in that devoted to the study of disorders and diseases of the circulation. Of this position the recently published volume of lectures by Sir Lauder Brunton affords an excellent illustration, for all through its pages we see how physiology aids the physician, not only in clarifying his conceptions of clinical facts, but in applying and inspiring his treatment of circulatory ailments.

For the execution of the work the author possesses the happy combination of advantages derived from his early laboratory training under the celebrated Ludwig, from his life-long love of physiology, and from his extended experience as a clinical worker and teacher. It has been said that the physician is—or should be—a physiologist and something more; and that "something more" is the practical quality of applying, not only his pathological, but also his physiological data to the work of the hour. The dominance of that quality in the author's handling of the material of his lectures is a prominent feature of the volume.

In the earlier lectures we have an exposition of the physiology of the circulation. The clear and comprehensive description of the forces at work will be appreciated, not only by professional readers—whether physiologists or clinicians—but by those members of the community who take an interest in the study of physiological subjects. Moreover, even the medical reader fairly conversant with clinical work on the circulation may, by the perusal of these lectures, gain something in the clearness of his conception of the fundamentals presented by an author who has the gift of exposition and happy illustration.

In the first lecture we have a description of the parts played by the heart, the arteries, capillaries and veins, the vaso-motor system of nerves, and the accessory aids to the circulation furnished by the fasciæ and muscles; these and cognate topics are discussed under such headings as sleep of the heart, motor and peristaltic action of arteries, accessory muscles of the circulation, arterial tension or blood-pressure and its regulation, the influence of the muscular and splanchnic areas, depressor nerves, independent pulsation of veins, &c.

But the physiologist and pathologist will be more particularly attracted to that portion of the lecture which is devoted to the study of the point of origin and the conductivity of the impulse which culminates in the contraction of the ventricle, a subject which has, especially of late years, fascinated the pathologist as well as the physiologist—for it affords the key to the irregularity of the heart's action, and to the dissociation of the auricular and ventricular contraction. It is now some twenty-five years since Gaskell demonstrated the continuous track of the impulse from the venous sinus, in which it originates, to the auricle, and from the auricle to the ventricle; and the soundness of this physiological conclusion has since been confirmed by the work of Stanley Kent, W. His, jun., and more recent workers (such as Tawara and Keith), who have established the existence of a specialised muscular tissue possessing neuro-muscular properties, which forms the anatomical basis of the track followed by the impulse from the sinus to the ventricle. In introducing this subject the author cites the work of Romanes on the medusa, a polyp which is circumscribed by a bell-shaped piece of contractile protoplasm margined by a nervous gangliated chain and a fringe of mobile tentacles. This work, though executed some few years before that of Gaskell, forms a happy illustration of the broad results of the inquiry into the conductivity in the heart muscle, and will well repay perusal.

Some recent workers hold that it is an inherent property of the heart muscle to originate and conduct the stimulus which causes the heart to beat, they regarding this function as independent of the nervous ganglia and the nerve fibres in the heart. The author is not one of these. He says, referring to his work with Cash:—

> "These experiments, which were not only very numerous but very varied, seemed to us to show that, just as in a medusa, there are in the heart two distinct channels, the nervous as well as the muscular, by which stimuli are conducted from one part of the heart to another, and that the nervous conduction may interfere with the muscular conduction" (pp. 32–4).

Furthermore, he points out that "the importance of the cardiac ganglia in originating the beats of the heart has been prominently brought forward since these lectures were given, by Dogiel and Archangelsky, *Pflüger's Archiv*, July, 1906" (p. 30); that "Kronecker and Imchanitzky have shown that the bundle of Stanley Kent and His (connecting the auricles and ventricles) can be ligatured without disturbing the coordination between the auricles and ventricles" (p. 225); and that Paukul has found nervous plexuses in that bundle, "injury of which disturbs coordination, while ligature of the muscular part of the bundle does not impair coordination" (p. 225).

In connection with this subject, the reader will also find further interesting matter in the appendices A and D. In appendix A the author treats on the conduction of stimuli and the contractility of organic tissues allied to that of the fibres of His and Purkinji in the heart—such as contractile vegetable protoplasm (producing the movements of plants), contractile animal protoplasm (amœba, leucocytes), neuromuscular cells (fresh-water hydra). Appendix D is an epitome of an interesting contribution by the author's old friend and fellow-worker of nearly forty years ago in Ludwig's laboratory, Prof. Kronecker, of Berne, who has done so much to advance our knowledge

of the physiology of the heart. From it we gather, among other things, that it was Kronecker who discovered "that the heart is not irritable during systole"—denominated by Marey the refractory period; that Kronecker and his pupils found that the heart "ceases to beat if its contents are deprived of all stimulating properties"—from which fact we may infer "that there is no true automatism in the ventricle, but only intermittent action to a constant stimulus"; that "no other material enables the heart to beat except serum albumin, and to a very slight degree, serum globulin"; that Bowditch's law (minimal stimuli causing maximum pulsations, or in a word "all or nothing") holds good *without any exception*; that the rhythmicality of the flow through the arteries causes much more fluid to pass through them than when the flow is continuous; and that self-massage of the heart and vessels is an important factor in maintaining the efficiency of the circulatory mechanism. The last-named topic (self-massage of the heart, arteries, lymphatics, and veins) is also fully discussed by the author, who points out its important bearing on the nutritive integrity of the heart and the arterial wall. The author suspects that some may consider he has devoted too much space to the consideration of self-massage of the heart and vessels, and the conduction of stimuli in the heart. There is no doubt, however, that he is justified by the scant reference to these subjects in the text-books and by their practical importance.

In lectures ii. and iii., and in the appendix B, we have a very full and well-illustrated description of most of the instruments which have been devised for the measurement of blood-pressure in man for clinical purposes. The variety in construction shows us what a large amount of thought and ingenuity have been expended in devising them, so as to satisfy as much as possible clinical needs and accuracy. The introduction of such devices into clinical work has always been regarded with suspicion by physicians, who ever since the days of Herophylus have trusted with implicit faith to the infallibility of the tactus eruditus. In view of this natural distrust it is therefore of some importance, when discussing the claims of these innovations, to attach due weight to the objections which may be advanced to their adoption. The author does not, however, touch on this aspect of the clinical employment of blood-pressure apparatus. Probably this omission has arisen from want of space or the unsuitability of the subject for treatment in these lectures. We are therefore left to infer that he highly appreciates the advantages derived from the adoption of the methods now in use for the clinical measurement of blood-pressure, and that the practical value of these methods is amply justified by observation and experience; and there is no doubt that that is the verdict of the majority of those who have so far adopted these methods. The test of their usefulness is measured by the help and satisfaction they afford in the daily routine of practice rather than in the discovery of minor defects, which actually do not count for anything in disturbing the conclusions of the physician in clinical work. The author has, therefore, wisely devoted a large portion of his lecture to this important subject, which more than any other has made it possible to apply our knowledge of the physiology of the circulation to the service of man.

To comment on the remaining lectures in which the author discusses in an instructive manner various diseases of the heart and their treatment would unduly extend this review, and introduce topics somewhat extraneous to the scope of NATURE.

But these remarks should not be closed without a reference to the profusion of excellent illustrations, which add greatly to the clear conception of the text, and the admirable indices, which facilitate easy and accurate reference.

JUSTUS VON LIEBIG.

Justus von Liebig. By Jacob Volhard. Band I., pp. xii+456. Band II., pp. viii+437. (Leipzig: J. A. Barth, 1909.) Price 24 marks.

THIRTY-FIVE years have passed since Liebig died, and we are at length presented with a biography worthy of the man and his work. At the time of his death innumerable articles on his life and achievements appeared in the newspapers and periodical press of practically every country in the world, and almost every known scientific society having relations with chemistry made reference to his splendid services, and to the irreparable loss which humanity had suffered by his decease.

Some of these, such as the memorable lecture of Hofmann, are among the classics of chemical biography. But a generation has had to come and go before the appearance of a work which would serve to fix for all time without question Liebig's true place in the history of the science he did so much to illumine and develop. The delay has not been without its compensations. Time is required to estimate the real value of such services as Liebig was able to render. The outcome of his work was not wholly apparent during his lifetime, or even in the years immediately following his death. Germany was barely a united nation in 1873. Although the seed of her supremacy in chemistry, and in many branches of the chemical arts, had been sown in the early Giessen days, and although he lived to see the signs of its abundance, Liebig died before the harvest was garnered. It is hardly garnered yet. The impetus which he gave to the study of chemistry still makes itself felt, not only in his native country, but throughout the world. To him, more than to any other man, is due the inception of the movement resulting in that development and extension of the industries dependent upon organic chemistry which is one of the most remarkable features of our times.

Liebig, a man of good fortune in his life, as the Romans say, is fortunate also in his biographer. With the possible exception of Hofmann, no more fitting choice could have been made than Prof. Volhard. The author and his subject were on terms of strong personal friendship, dating, indeed, from Dr. Volhard's early youth. He was, in fact, like a son of the house in Liebig's family. For some years Dr. Volhard

acted as Liebig's assistant, and ultimately was entrusted by him with the delivery of the course of lectures on organic chemistry which he regularly gave in the summer semester. It is this intimate personal knowledge of his subject, and the whole-hearted sympathy, appreciation, and respect which a life-long intercourse had engendered, that gives to Dr. Volhard's work its special and peculiar value.

It is quite impossible within the compass of a notice such as this to do more than briefly indicate how admirably Dr. Volhard has risen to his opportunity. As already stated, the work is worthy of the subject, and no higher praise is possible.

Justus von Liebig—the first of his name to be ennobled—belonged to an Odenwald family which could trace its ancestry as far back as 1575. Some of the members spelled the name as it is pronounced, viz. Liebich. Justus was the second son in a family of ten children, and was born in 1803. His father, Johann Georg Liebig, was a druggist and drysalter in Darmstadt, who had his shop in a little house in the Kaptaneigasse, one of the oldest streets in the old town. His mother, Marie Caroline Moser, was described as an active little woman with the bright eyes and sharply cut features of her famous son. Indeed, from her Liebig seems to have inherited also many of his mental and intellectual characteristics, his energy, and remarkable power of work.

It is easy to determine the conditions which made Liebig a chemist. From his earliest years he was familiar with the sight of chemical operations. Chemical utensils and apparatus were his toys, and for a time he had no other aim in life than to follow his father's occupation. But as his knowledge increased his interests widened, and science eventually claimed him. Even before he left the gymnasium he had settled in his own mind what his life's work was to be—"Chemiker will ich werden, nicht Apotheker"—and accordingly in 1820 he was sent to Bonn to listen to Kastner's dull and formal prelections. In the following year he went with Kastner to Erlangen, where he published his first scientific communication. It appears in Buchner's *Repertorium der Pharmacie*, xii., 412, with a commendatory notice from Kastner, under the title "Einige Bermerkungen über die Bereitung und Zusammensetzung des Brugnatellischen und Howardschen Knallsilbers. Vom Herrn Liebig, der Chemie Beflissenen aus Darmstadt." With August von Platen as his friend, Liebig was "ein ganzfideler Student," to whom the Erlangen "Karzer" was not altogether unknown, as the acts of the university testify. Kastner was not very inspiring, and knew nothing of analysis.

From Erlangen Liebig passed to Paris, where, thanks to the interest of Humboldt, he was well received by Gay-Lussac, Thenard, Dulong, Biot, and the rest of the remarkable group which made Paris the chief centre of scientific activity of that age. A new era dawned on Liebig; with Gay-Lussac his relations became especially cordial. They worked together on fulminic acid, and under Gay-Lussac's inspiration and direction Liebig became an investigator. "Liebig," says his biographer, "bewahrte dem väterlichen Freund die wärmste Verehrung. Sein Zusammenarbeiten mit Gay-Lussac bildet den Glanzpunkt seiner Jugend." To the end of his days Liebig always spoke of this association with the warmest feelings of pleasure and gratitude. He was wont to relate how, when some particularly difficult analysis had succeeded, or when some new and surprising fact had been elicited, the two investigators sought to relieve their excitement by waltzing together round the laboratory table.

It was mainly through the good offices of Gay-Lussac, working through his friend and fellow academician Alexander von Humboldt, that the Grand Duke of Hesse was led to interest himself still further in the fortunes of the young man "der Chemie Beflissenen aus Darmstadt," and in 1824 Liebig, in the twenty-first year of his age, was appointed, without previous consultation with the faculty, and somewhat to their displeasure, extraordinary professor of philosophy at the University of Giessen. On the death of Zimmermann in the following year he became ordinary professor and sole teacher of his subject. Liebig's life during the twenty-eight years he remained at Giessen is, of course, the main theme of Dr. Volhard's book. The principal features of his Giessen career are familiar to everyone who has even the slightest acquaintance with the development of chemistry during the second quarter of the nineteenth century, but these features are now filled in by Dr. Volhard with a degree of detail which is almost Boswellian in its completeness and exactitude. One rises, in fact, from the perusal of the narrative with the conviction that surely the last word on the subject has been said. Liebig's chief work was, of course, done at Giessen, and the twenty years of his subsequent life at Munich, whilst it in nowise diminished, hardly added to the world-wide and imperishable reputation which his sojourn at the "little university on the banks of the Lahn" had secured for him.

Liebig's life was so full, his services were so remarkable, and his achievements so striking, that not even the most unskilful of biographers could fail to invest his story with interest.

Dr. Volhard is very far from being an unskilful biographer, and he has put together his great mass of material with circumspection and judgment. Much of Liebig's correspondence has already been published, and his relations to his contemporaries and to the scientific movements of his time are already well known, and passing references to these matters, sufficient to make the story complete, were alone necessary.

Exception might perhaps be taken to certain features in the construction and plan of the work, and, as a book for general readers, it suffers from the common fault of biographies of being over-elaborate. But Dr. Volhard may urge that his book was primarily intended for those who have a lively and abiding interest in Liebig, viz. the chemists who revere his name and who seek to be inspired by his example, and these will certainly not cavil at the wealth of detail which is manifested in this monumental work.

T. E. Thorpe.

THE CONSTRUCTION OF SHIPS.

The Design and Construction of Ships. By Prof. J. H. Biles. Vol. i. Calculations and Strength. Pp. viii+423; 280 illustrations. (London: C. Griffin and Co., Ltd., 1908.) Price 25s. net.

THIS is the first of two volumes dealing with modern methods of procedure used in connection with the design and construction of ships. It embodies details of courses of instruction given to students of naval architecture during the seventeen years the author has occupied the chair of naval architecture in the University of Glasgow. That professorship was founded about twenty-five years ago by the generosity of Mrs. John Elder, widow of a celebrated marine engineer, and was the first attempt made in any British university to provide instruction in the science and practice of shipbuilding. The Admiralty had previously established schools of naval architecture, mainly for the purpose of training their own shipbuilding officers, and it is noteworthy that all the men who have held the Glasgow professorship, the late Dr. Elgar, Mr. Jenkins, and Prof. Biles, were originally trained for the Admiralty service, but quitted it for appointments in private establishments. All of them had attained eminence in the practice of their profession before becoming teachers; they continued their practice in the design and construction of ships during the period of their professorships. Students at Glasgow consequently have had the good fortune to be taught by men who themselves received a thorough scientific training at the outset of their careers, had maintained close touch with current practice, and were familiar with the latest advances and improvements in shipbuilding and marine engineering. That fact is apparent throughout the volume under review, and adds much to its value.

The book is described in the preface as primarily intended for young students, and this intention has been admirably fulfilled. The author also ventures to hope that "many who have been students and some who in their daily work are interested in the problems dealt with may find some assistance" from the perusal of its pages. This hope will undoubtedly be realised. The arrangement of the book is excellent, its style concise and clear. Detailed explanations are given of processes of calculation and methods of procedure, in a form which should suffice for the guidance of those desirous of making work of that nature the principal occupation of their lives. Many of the sections including those containing illustrations of types of ships, details of tonnage laws, rules for freeboard, and other subjects—should prove of interest to all persons connected with shipping. The plates, diagrams, and other illustrations are numerous, and the book as a whole is well produced. The volume has its own index.

The author does not lay claim to much originality, although not a little original work done by himself has been embodied. The book is valuable also for its tabulated data, much of which is drawn from professional work done by the author, or placed at his disposal by other authorities.

Growing as it has done out of courses of instruction given to students at Glasgow, the book has naturally taken a form which adapts it for use as a textbook for students generally. Consequently it should greatly assist teachers as well as students of naval architecture, and particularly those in Great Britain and the United States. For a long time there has been a need for such a book; and in saying so, no discredit is cast upon smaller and less expensive textbooks previously produced, largely with a view to use by less advanced students than those who follow complete university courses in naval architecture.

This volume is subdivided into three sections. In the first, methods of calculating areas, volumes, and positions of centres of gravity are dealt with. A full account is given of applications of descriptive geometry to the delineation of the forms of ships and of various parts of ship-structures. Descriptions of various types of ships employed for war and commerce are also given, and abundantly illustrated. The information is elaborate and up to date, as is indicated by the fact that it includes drawings of the *Dreadnought* and *Invincible* classes in the Royal Navy; particulars of the latest ocean-going destroyers and submarines; descriptions of many types of cargo and passenger steamers; and details of steam and sailing yachts.

The second section of the volume is devoted to ship calculations, and its scheme is comprehensive. It includes details of numerical methods, as well as interesting descriptions of mechanical integrators and integraphs which have been devised in recent years for measuring areas, moments, and moments of inertia of plane curves. Naval architects have been largely assisted by these instruments, and the drudgery of numerical calculation has been greatly reduced. All classes of engineers, as well as many scientific men, will be interested in the descriptions given of the applications of these mechanical integrators to calculations for the displacements, positions of centres of buoyancy and metacentres of ships, and work connected with determining the conditions of stability.

The important subject of the strength of ships is one with which Prof. Biles has been much concerned, and it is treated exhaustively in the third section of the book. Investigations and experiments of a special character were carried out by a committee (of which he was a member) appointed by the Admiralty about six years ago after the loss of the torpedo-boat-destroyer *Cobra* in the North Sea. Prof. Biles and his assistants and students at Glasgow undertook a great mass of calculations for representative vessels on behalf of that committee, and also analysed the results of experiments made on a typical torpedo-boat-destroyer in order to determine her behaviour when subjected to exceptional longitudinal bending moments which produced sensible changes of form. Much of the information in regard to these experiments had been published by Prof. Biles in the Transactions of the Institution of Naval Architects, but it is brought together in the volume under review in a form which will be useful for reference, and which adds to the

interest of his general treatment of the strength of ships.

The book will be heartily welcomed by all connected with the design and construction of ships; the appearance of the second volume will be awaited with interest.

W. H. WHITE.

HEREDITY AND EDUCATION.

Education and the Heredity Spectre. By Dr. F. H. Hayward. Pp. xv+147. (London: Watts and Co., 1908.) Price 1s. net.

WHAT Mr. Bernard Shaw means when he says that "the bubble of heredity has been pricked" is that the theory that the moral characters acquired by an individual during his lifetime are transmitted to his descendants has been exploded. We are all, including the author of the book before us, pretty well agreed that this is so. It is not supported by the scanty evidence on this point which the biologist has collected. Nor need we grieve that it has gone. For, if it can be maintained that a belief in it was an incentive to virtue, it is equally certain that such a belief was an excuse for vice, as was clearly seen by a little girl who, when told by her nurse that if she was naughty her grandchildren would be naughty too, pointed out that, if that was true, the reason that she was naughty was that her grandmother had been.

The conclusion reached by Mr. Shaw as to the bearing of the pricking of the bubble on education is that "the vilest abortionist is he who attempts to mould a child's character." That reached by Mr. Hayward is the diametric opposite of this. He is a Herbartian. Herbart asked:—

"Does a human being bring with him into the world his future shape, or does he not? In respect to his body he doubtless does; but that is not our question. We speak of the mind, the character, the entire disposition."

And Herbart's and Mr. Hayward's answer is that he does not; and that, that being so, it is not merely legitimate, but desirable, to attempt to mould a child's character.

But before we proceed further we must make sure that we keep two questions, which are probably puzzling our mind at the same time, perfectly distinct. One is a question for the biologist, the other for the educationist. The one is, "Can a child's character be moulded?" the other, "Is it desirable to do it deliberately?" With regard to the former question, the answer given by Dr. Archdall Reid, who has devoted much thought to this point, is "Yes." According to Dr. Reid, all the attributes which distinguish a civilised man from a barbarian (the two terms are relative, of course) have been acquired by the former during his lifetime. If this is true, an English boy brought up from birth in a Zulu kraal will, when a man, have the morals and ideals of a Zulu. He will only differ from the other inhabitants of the kraal in having a paler skin and the other physical characters which distinguish the two races. Such experiments may have been made, but it is highly unlikely that they have been accurately recorded. The presence of anyone capable of doing so would spoil the conditions of the experiment. But even if this view of the nature of our morality is correct, it does not follow that it is desirable to attempt to mould a child's character. It rather shows that we cannot help moulding it by everything that we do, and that any little deliberate attempts that we make will count for so little in comparison with what we have already done, and will go on doing, that they will not make much difference.

From the educational side the book is well worth reading, and the subject discussed is of first-rate importance; but our author is not a biologist either by sympathy or achievement. Was it worth while to poke fun at Mendel for his researches on green peas (p. 134)? People lay so much too much stress on the material that is dealt with in an investigation. Personally, we set more value on a man who discovers, not *everything*, as some Mendelians hold, but, say, "a rough quarter" by experiments "with green peas," than on one who discovers practically nothing by an excursus on man. We quote the whole passage:—

"(3) *Mendelism.*

"The question of heredity has entered on a new phase during the past ten years, owing to the unearthing of Mendel's researches on green peas. The plant again! We are to discover the laws of human nature by the study of heredity in non-conscious, non-moral plants."

Does Mr. Hayward really think that we investigate natural processes for the benefit of those who apply the information which we give them? The reason that Mr. Hayward dislikes the plant so is that, according to him, the non-Herbartian doctrine of education is based on what he calls the "plant" metaphor.

"The future form of a plant is admittedly determined in advance. True, there are 'variations' and 'mutations,' the laws of which we are likely, sooner or later, to know; true, also, *even plants* [1] are plastic in a measure, to environmental influences. Broadly, however, we may say that the fate of a plant is fixed by the nature of the germ from which it springs."

We quote this to show that Mr. Hayward's biology is shaky. For it is now generally recognised that one fundamental difference between animals and plants is the much greater susceptibility of the latter to environmental changes.

RECENT STUDIES IN ATMOSPHERIC ELECTRICITY.

Die Luftelektrizität. Methoden und Resultate der neueren Forschung. By Prof. Albert Gockel. Pp. vi+206. (Leipzig: S. Hirzel, 1908.) Price 6 marks.

OF late years there has been great activity in this country in investigating electrical phenomena in gases and in advancing and discussing theories as to the nature and properties of ions. But this work has been mainly done in the laboratory or by mathematicians. In central Europe, thanks largely to the influence of Exner and of Elster and Geitel, there have been many workers studying the electrical phenomena presented by nature. Amongst them Prof. Gockel takes a distinguished place. In the present volume he gives an exceedingly up-to-date account of our knowledge of atmospheric electricity. The amount that has recently been written on the subject will

[1] The italics are ours.

impress itself on anyone who refers to the *Physikalische Zeitschrift* or the publications of the Vienna Academy. The references in the present volume are evidence of Prof. Gockel's familiarity, not merely with recent work in German, but also with that in English, whether done here or in America. He makes, for instance, numerous references to Simpson's observations in Lapland.

The book consists of a three-page introduction, five chapters, and a short conclusion, and has a table of contents. Chapter i., pp. 4 to 61, deals with the electrical conductivity of the atmosphere. After describing Elster and Geitel's dispersion apparatus, and the instruments of Ebert and of Gerdien for measuring ionic charges and conductivity, it gives an account of the results obtained with these instruments by different observers in different places, and deals with the questions of diurnal variation and the influence of various meteorological conditions. Chapter ii., pp. 62 to 120, deals mainly with the potential gradient and its determination by means of water-droppers, flame and radium collectors. This includes the results obtained —especially in recent years—at the ground and those derived from balloon ascents. The diurnal and annual variations in the potential gradient, the relationships of potential gradient and ionisation, and the influence of meteorological conditions are amongst the subjects discussed. Chapter iii., pp. 120 to 149, describes the measurements by Gerdien and others of the vertical current in the atmosphere, deals with the charges brought down by rain and snow, and includes two or three pages on aurora. As evidence of its up-to-date character, it may be mentioned that it describes Mr. C. T. R. Wilson's apparatus for measuring the earth-air current. Chapter iv. is devoted to earth-currents. Its length, only $9\frac{1}{2}$ pages, forbids much detail, but there is an account of several of the more important observations, including those by Weinstein in Germany. Chapter v., pp. 159 to 202, deals with the sources of ionisation in the atmosphere. It discusses the radio-activity of air from the ground, and of rain, and the radio-active emanation in springs, the observations made by Elster and Geitel and others with negatively charged wires, and refers to recent work by Gerdien, Rutherford, Strutt, Campbell, Dike, Eve, and others. A few pages at the end relate to various theories.

In a book of such modest dimensions it is inevitable that some parts of the subject should not be very fully discussed, but it is unquestionably a work which every serious student of atmospheric electricity should possess and study. Very few points call for criticism. There are, however, two historical references which seem to overlook the work of British investigators. Mascart is referred to on p. 80 as the first to introduce photographic registration of potential difference, but in reality the Kelvin water-dropper at Kew has recorded photographically since 1861. Again, the discovery of the resemblance between the diurnal variations of potential gradient and barometric pressure is said on p. 114 to have been made by Hann in 1889. Prof. J. D. Everett, however, detected it in 1867 (*Phil. Trans.*, vol. clviii., p. 358, and plate xxi.).

C. CHREE.

OUR BOOK SHELF.

The Ethical Aspects of Evolution, regarded as the Parallel Growth of Opposite Tendencies. By W. Benett. Pp. 220. (Oxford: The Clarendon Press, 1908.) Price 6*s.* net.

THIS book is full of original opinions vigorously and uncompromisingly expressed. As the title indicates, the author's main thesis is that the process of evolution does not mean the progressive elimination of evil and pain, or a progressively increasing surplus of good and pleasure. He adduces biological evidence to show that the organism which has attained the finest adjustment to its environment is the organism which can be most easily thrown out of adjustment, and the one to which misadjustment, when it comes, is most disastrous. So history teaches us that if civilisation has meant higher forms of virtue, it has also meant lower depths of vice; and that as our knowledge increases so does the consciousness of ignorance.

From this point of view, Mr. Benett makes an effective destructive criticism on all optimistic evolutionary theories of ethics which have as central principle the possibility of perfect adjustment and the extrusion of all inharmonious factors from experience. He then proceeds to put forward his own theory. Failing the criterion of a net surplus result of progress in good or pleasure, Mr. Benett holds that our system of valuations must rest on the conception of progress itself. A teleological basis, he admits, would be more adequate. But we are unable to find any finite end which will give unity to the divergent tendencies of human nature; and the transcendental end, though we are compelled to posit it, is for ever beyond our ken. The essential characteristic of progress is, for Mr. Benett, increase of force; it is this which in the last possible analysis commands man's esteem and admiration, and affords a criterion of good and evil.

There is here an attempt to unite a scientific neutrality with a positive ethical construction. Progress is no increase in the net value of life; it means the impartial development of good and evil; yet progress must be our criterion of value and good. One need only point to Mr. Benett's criticism of hedonism, where he points out that just because pleasure is an impartial stimulant of all sorts of action it cannot be the criterion of good, to show the inconsistency of this position. To avoid the difficulty by making progress represent only the positive aspect of evolution is to fall on the other horn of the perpetual dilemma of ethical construction, and make good the criterion of good. Apart from this defect of fundamental theory, Mr. Benett's book shows considerable power of psychological analysis; his treatment in the later chapters of complex moral facts and concrete virtues is often admirable. His argument is always forceful, his style is powerful, and one feels throughout the presence of a straightforward insistence that we must face the facts as we find them of human nature and the world. These are qualities which go far towards a valuable re-handling of moral problems.

The Poisonous Terrestrial Snakes of our British Indian Dominions and how to recognise Them. By Major F. Wall. Second edition. Pp. x+69; illustrated. (Bombay: Natural History Society, 1908.) Price 2 rupees.

To those whose travels have never extended beyond western Europe it is a difficult matter to realise how largely poisonous snakes loom in the life of our native fellow-subjects in India, or to appreciate the heavy annual list of casualties due to snake-bite. To mitigate the evil, the European and the native medical staff of the country are now bringing into play the latest remedies of their science, but they are frequently

hampered in their endeavours by the difficulty of identifying the particular kind of noxious serpent with which they may be called upon to deal. It is largely with the view of supplying a ready method of making such identifications that the unpretentious work before us has been presented to the public. That it has been heartily appreciated is made evident by the fact of its having reached a second edition, after the sale of a first issue of 2500 copies. The author relies on the arrangement, size, and number of the scales as affording the easiest clue to the identification of species, and for this purpose gives figures of the scaling of certain parts of the body or head of a considerable number of the thirty-nine species recognised which in his opinion render identification easy and certain.

In the present edition the author has ventured to recognise more species than are admitted in Mr. Boulenger's volume in the "Fauna of British India." He is of opinion, for instance, that under the name of *Ancistrodon hypnale*, two species—one from Ceylon and the other from the Western Ghats—have been confounded, while a new krait is recognised from Assam, and the *Bungarus candidus of* Boulenger is split up into several species. In addition, *Pseudocerastes persicus* has recently been identified in British India. Apart from the special purpose in connection with snake-bite, the book is a useful and handy guide to the Indian "Thanatophidia." R. L.

Gray's New Manual of Botany. Re-arranged and extensively revised by B. L. Robinson and M. L. Fernald. Seventh edition. Pp. 926. (New York: American Book Company, n.d.)

THIS well-known flora of the central and north-eastern parts of the United States of America was originally compiled in 1848 by Dr. Asa Gray, who was professor of natural history in Harvard University. It has passed through six editions, and has been revised three times, the last revision having been undertaken by Dr. S. Watson and Prof. J. M. Coulter in 1890. Another edition had become desirable if only to bring the book into conformity with the pronouncements of the International Botanical Congress at Vienna, and no more opportune occasion was likely to arise for carrying out at the same time the practically inevitable displacement of the arrangement of Bentham and Hooker's "Genera Plantarum" by the more modern system elaborated by Dr. Engler. These sweeping reforms have been effected by the new editors, who are botanical professors at Harvard University, and therefore officially entitled to prepare the flora, of which the copyright is held by the university.

The authors have also modified the geographical limits covered by the manual, whereby certain territories in the west are excluded, and considerable areas in Quebec, Ontario, and other Canadian provinces are included. The changes do not by any means end here; practically the arrangement of every important *family*—to use the word officially recommended for the group, better known as an *order*—and every large genus has been re-cast, so that the title of the book has been advisedly qualified. The assistance of specialists has been obtained for the descriptions of the grasses, orchids, Cratægus, and a few other genera.

The flora is confined to Pteridophyta and Spermatophyta; there is a considerable increase in the total number of species, that now exceeds four thousand. Under the genus Panicum, seventy-three species are distinguished, and under Carex as many as a hundred and eighty-five. The forms of Cratægus, a species that is highly variable in America, are brought under sixty-five species by Mr. W. W. Eggleston.

Undoubtedly the revision will be cordially welcomed by botanists, and should prove especially useful to botanical workers in south-eastern Canada. The admirable series of analytical keys that were a feature of the older editions have been maintained, and further help is given for difficult genera in the shape of small illustrations, by the side of the text, of those parts of the plant that furnish diagnostic characters.

The New Word. By Allen Upward. New edition. Pp. 317. (London: A. C. Fifield, 1908.) Price 5*s.* net.

Scientific Corroborations of Theosophy: a Vindication of the Secret Doctrine by the Latest Discoveries. By Dr. A. Marques. Revised and greatly enlarged edition. Pp. iv+152. (London: The Theosophical Publishing Society, 1908.) Price 2*s.* 6*d.* net.

MR. ALLEN UPWARD describes his book as "a plea for reason against authority," and proceeds to discuss a number of problems of modern science from a layman's point of view. Men of science will approve the spirit in which Mr. Upward writes, even if they remain unconvinced by his arguments.

Readers will discern from the title to his book the line of thought which characterises the volume of Dr. Marques.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Boiling Point of the Radium Emanation.

IT was shown by Rutherford and Soddy in 1903 that the radium emanation was condensed from the gases with which it was mixed at a temperature of about −150° C. From observations of the range of temperature of condensation and volatilisation it was concluded that the condensed emanation exerted a sensible vapour pressure. This has been confirmed by later experiments, using much larger quantities of emanation. Sir William Ramsay and Cameron have pointed out that the emanation, condensed in a glass tube kept at the temperature of liquid air, can be removed by continuous pumping, thus indicating appreciable vapour pressure even at that low temperature. I have found that the rate of removal of the emanation in this way increases rapidly as the temperature of complete volatilisation is approached.

In the initial experiments of Rutherford and Soddy only very small quantities of radium were available, and the partial pressure of the emanation in the experiments was exceedingly small. If the emanation behaves like an ordinary gas, it is to be expected that the boiling point of pure emanation at atmospheric pressure should be much higher. I have recently made experiments to test this point. As the volume of pure emanation available in the present experiments was only about 1/20 cubic millimetre it was necessary to employ special methods to investigate the boiling point of the emanation at various pressures. Purified emanation corresponding to the equilibrium amount from about 100 milligrams of radium was compressed into a fine glass capillary of about 1/20 millimetre diameter. The end of the capillary dipped into a pentane bath, which was cooled down to any desired temperature, measured by means of a thermocouple. The point of initial condensation was marked by the appearance of a brilliant point of phosphorescent light, due to condensed emanation, at the coldest part of the capillary. In this way I have found that the temperature of initial condensation of the emanation rises from about −150° C. at a very low pressure to about −65° C. at atmospheric pressure. This fixes the boiling point of the emanation at atmospheric pressure at about −65° C., or 208° absolute.

As it is a difficult matter to purify completely the small volume of emanation and to keep it pure, the observed pressure of the emanation and mixed gases at the temperature of condensation was corrected for by taking the true volume of the emanation from 1 gram of radium in equilibrium as 0·585 cubic milligram. This calculated volume is in excellent agreement with the minimum value which I have found experimentally. As the emanation is apparently an inert gas of atomic weight 222, it is of interest to compare its boiling point with those of the heavier inert gases found in the atmosphere. The boiling points of argon, krypton, xenon, and emanation are, respectively, 86·9, 121·3, 163·9, and 208 degrees absolute. It will be noted that as the boiling point of krypton is about intermediate between that of argon and xenon, so the boiling point of xenon is nearly the mean between that of krypton and emanation.

If the capillary tube containing pure emanation is quickly placed in the pentane bath, cooled well below the temperature of initial condensation, under a microscope small drops of liquid emanation are seen on the walls of the capillary. The position of each globule is marked by a brilliant local phosphorescence of the glass of the capillary.

E. RUTHERFORD.

University, Manchester, February 13.

Crocodiles and Tsetse-flies.

My attention has been directed to a paper read before the Royal Society of Arts by Mr. James Cantlie on January 27 called "The Part played by Vermin in the Spread of Disease," published in the society's journal (January 29, pp. 202–4). Mr. Cantlie is there reported to have said:—"In sleeping sickness the disease is transmitted by the tsetse-fly, and the crocodile is believed to be the alternative host, the fly serving as a carrier only" (p. 204).

I do not know upon what evidence or upon whose observations Mr. Cantlie based his statement concerning the crocodile, but to judge from many similar statements that have appeared from time to time recently in the Press, the idea seems to be generally prevalent that Prof. Koch either observed or believed that the crocodile was a "reservoir" host for the human trypanosome (*Trypanosoma gambiense*), just as big game is for the trypanosome causing the "nagana" disease of animals (*T. brucei*). Prof. Koch, however, has never expressed such a view in his published papers. In his last work on this subject, "Über meine Schlafkrankheits-Expedition" (Berlin: Dietrich Reimer, 1908), he wrote:—"Dem ersten . . . Krokodil entnahmen wir sofort frisches Blut, um Präparate zu machen und Kulturen anzulegen, und wir hatten in diesem Falle auch insofern Glück, als die Kulturen gelangen, wodurch wichtige wissenschaftliche Resultate erhalten wurden. Namentlich konnte auch festgestellt werden, dass das Blut des Krokodiles zwar Trypanosomen, *aber nicht diejenigen der Schlafkrankheit enthält*" (the italics are mine).

All that Prof. Koch showed was that the crocodile in the Victoria Nyanza is infected by a species of trypanosome, and that tsetse-flies (*Glossina palpalis*) feed on the blood of the crocodile. Both these facts had already been made known by English observers. The bare fact that the crocodile may be infected by trypanosomes is no evidence for connecting this reptile with sleeping sickness. The perch, bream, tench, and other fishes in the Norfolk Broads also commonly harbour trypanosomes in their blood, but are not to be regarded as a danger to mankind on that account. There is, in fact, no evidence whatever that the crocodile serves as an "alternative host" of the human trypanosome. It is inherently improbable that any reptile should play such a part.

I hold no brief for the crocodile, and should hear of its extirpation in the Victoria Nyanza without the least regret; I only desire that our scientific knowledge of the sleeping-sickness trypanosome should be correctly stated. It is possible, and indeed for many reasons probable, that a "reservoir" host for *T. gambiense* exists, but none has been discovered as yet. Only the human species has been found so far to be naturally infected with the trypanosome of sleeping sickness, although many other *mammals* can be inoculated with it as a laboratory experiment.

Rovigno, February 10. E. A. MINCHIN.

The Production of Prolonged Apnœa in Man.

IT is a matter of common knowledge that the time for which the breath can be held is increased by a preliminary bout of deep breathing, and divers often make use of this fact to increase the time for which they can remain under water. So far as I am aware, it is not usual to perform this forcible respiration for more than a short period, the pearl-divers of Ceylon, for instance, taking only a few deep breaths before descending; but in order to get the maximum effect a prolonged period is necessary. In my own case I found that whilst with no preliminary forced breathing I could hold my breath for only forty-two seconds, I could hold it for 2m. 21s. after one minute's forced breathing, for 3m. 21s. after three minutes' breathing, and for 4m. 5s. after six minutes' breathing (*cf. Journ. Physiol.*, vol. xxxviii.). The effect of the forced breathing is to wash out such considerable quantities of carbon dioxide from the blood and body tissues that even at the end of the three or four minutes' apnœa they contain less of the gas than when the breath is held for forty-two seconds without any preliminary forced breathing.

In theory, therefore, the deeper, more rapid, and more prolonged the forced respiration the greater its efficacy; but it is not so in practice. With some people the sensations produced by even a minute or two of forced breathing are very unpleasant. The hands and feet tingle and become numb, a dizziness is felt, and there is a strong disinclination to continue the breathing (*cf.* Haldane and Poulton, *Journ. Physiol.*, vol. xxxvii.). In my own case a period of eight minutes' breathing caused the muscles of the hands to pass into a condition of tonic rigidity, and they remained completely paralysed for the first 1½ minutes of the subsequent apnœa. Doubtless the unpleasant sensations are diminished by practice, but it is probable that for ordinary purposes it would be best not to continue the forced breathing for more than two or three minutes. Also there is a distinct element of risk if a diver remains under water almost to his limit after forced respiration. The amount of oxygen left in the lungs and blood then becomes so low that there is danger of fainting. Haldane and Poulton quote a case, of which they were informed by Dr. Collier, in which a diver lost consciousness when at the bottom of a swimming-bath after he had employed forced breathing to prolong his stay under water. Fortunately, he was rescued before death occurred, but undoubtedly the chance of fatality is increased by a preliminary forced respiration.

In the absence of forced breathing, the accumulation of carbon dioxide in the blood when the breath is held affords a natural safeguard, for it stimulates the respiratory centre to action with ever-increasing force, and ultimately compels respiration before the oxygen in the system has sunk to danger-level. However, the risk due to oxygen deficiency can be readily overcome. Hill and Flack have shown (*Journ. Physiol.*, vol. xxxvii.) that if a few breaths of oxygen are taken during quiet breathing, the time for which the breath can be held is generally more than doubled. Not only is the oxygen want of the system thereby eliminated, but, in addition, the oxygen renders the respiratory centre considerably less sensitive to carbon dioxide, and so permits it to accumulate to a greater extent than usual in the body. The same thing holds after forced breathing, and I found that if one to four breaths of oxygen were taken at the end of the forced respiration, the breath could be held about twice as long as in absence of oxygen. After one minute's forced breathing I held my breath for 4m. 18s.; after three minutes' breathing for 6m. 34s., and after six minutes' breathing for no less than 8m. 13s.

So far as I can ascertain, the world's record for a professional diver remaining under water in a tank was made by Miss E. Wallenda in 1898, when she reached 4m. 45⅕s.

I do not know in what way divers prepare themselves for such feats, but presumably it is by a preliminary forced breathing only, without oxygen inhalation. Hence this record is probably comparable with my record of 4m. 5s., and in that case it follows that forced breathing, together with oxygen inhalation, might enable some individuals to stay under water for nine or ten minutes. Moreover, they could achieve such times without any risk of loss of consciousness. Even at the end of my eight minutes' record the air in my lungs still contained 46 per cent. of oxygen, or three times the normal amount.

The practical applications of this method of forced breathing and oxygen inhalation are obvious. Prof. Herdman states (Report of Ceylon Pearl Oyster Fisheries, part i., p. 63; part ii., p. 13) that the maximum time the best pearl-divers (the Arabs) remain under water is, in his experience, only ninety seconds, whilst the Tamil and other divers vary from thirty-five to fifty seconds. Of course, one would not for a moment expect them to attain the times above mentioned, as they are performing violent muscular work whereby the rate of production of carbon dioxide by the body is greatly increased. Still, there is little doubt that if they performed about two minutes' forced breathing, and took a single deep breath of oxygen at the end of it, they could, without risk, double or treble their average time under water. This might be of especial value to them when fishing in the deeper waters. Prof. Herdman says that while the usual limit of the divers is about nine fathoms, exceptional divers could go to fifteen fathoms, "but they had barely time to secure a single handful of the bottom before having to come up in an exhausted condition." The method might also be of value to sponge-divers, and to some extent also for rescue work in mines and drains poisoned by foul air, when proper rescue apparatus was not available.

22 Norham Road, Oxford. H. M. VERNON.

The Isothermal Layer of the Atmosphere.

THE difference of opinion between Mr. Hughes and myself apparently comes to this; he considers (February 11, p. 429) that radiation plays an important part in the temperature that is recorded by meteorographs sent up with a balloon, and I think that, save in exceptional circumstances, radiation may be neglected. We are agreed in stating that the temperature of the metal strip can only be altered by contact with the air and by radiation, and the only question is the relative values of these two causes. Furthermore, I gather that Mr. Hughes thinks that whether the ascent be by night or day, after a certain height the temperature is unduly raised by radiation from what he calls the hot planet.

Now, first, the thermograph is made of polished metal, and is protected by a polished metal case, and it is well known that a polished metal surface is not susceptible to radiation. One need only mention the double vacuum bottle in which liquid air is kept, the commercial "thermos flask." Loss or gain of heat by radiation is practically excluded by silvering the internal surfaces.

Secondly, it must surely be admitted that radiation must be very different by night from what it is by day. It is true that the sun subtends but a small solid angle, and the earth an angle of nearly 2π, but the power of radiation varies as the fourth power of the absolute temperature. In saying that all radiation was insignificant compared with that of the sun, I was thinking of ordinary experience. In the tropics a man protects himself against the sun; to quote a very ancient writing, "there is nothing hid from the heat thereof." There are places in the high valleys of Switzerland where in calm, sunny weather a person may sit out of doors in the sun in perfect comfort, although the country round is deeply covered with snow and the temperature is far below the freezing point. On the other hand, in the Arctic and Antarctic winter it is protection from the wind that is sought; all accounts agree that if there be no wind extremely low temperatures are not unpleasant, and loss of heat by radiation is not feared.

But Mr. Hughes admits that radiation is stronger by day, and says that if it is not apparent on the trace it must be because the traces differ so much *inter se*. This is a question of fact, and I can only refer him to the published records and to my previous statement that traces made in the day do not differ from those made at night. There is a striking similarity about the general form of all the traces, excepting those obtained in the daytime from a balloon which did not burst.

With regard to the vertical speed, we know that the time occupied in falling is about half that occupied in rising, because we have been able to ascertain by observations with a theodolite that the horizontal distance passed over during the fall is about half that passed over during the rise. We do not now use any parachute, and we used not to use one of more than 1 sq. foot area. The cross-section of the balloon before bursting is probably 25 sq. feet to 30 sq. feet. Inasmuch as at 20 km. height the air density is only one-sixteenth that at the ground-level, the initial rate of fall will be four times the final rate, and must therefore be greatly in excess of the rate of ascent. Notwithstanding this, the temperatures recorded are to all intents and purposes identical. Differences exceeding 3° C. between the up and down trace at the same height are very rare; 6° C. is the maximum recorded, and anything more than 4° is only produced by change of level of an inversion surface in the lower strata occurring during the ascent. W. H. DINES.

Barometric Oscillation.

IN NATURE of December 3, 1908 (p. 130), Mr. Dines, in reference to a previous note upon the semi-diurnal barometric oscillation, gave as his opinion that the semi-diurnal temperature oscillation is the result of pressure variation.

In connection with this question, it seems to me of some value to give here a couple of results derived from the Batavia observations. They are related to pressure oscillations of extra-terrestrial origin, like the semi-diurnal variation, and show a pressure change followed by a change of temperature.

At Batavia the well-known barometric oscillation with a period of $3\frac{1}{2}$ years is very definite. It is followed by an equally distinct temperature oscillation of the same period. The difference in time is $6\frac{1}{2}$ months. The temperature, moreover, shows the remarkable fact that the seven-yearly means from 1871–1905 are increasing regularly from 0°·08 C. to 0°·10 C. every seven years, so the temperature of the air increases by about 0°·01 a year.

In the second place may be mentioned the influence of the 26-day period of the sun's rotation on meteorological data. A corresponding pressure oscillation is clearly shown. It is followed after nine days by a variation, of the same kind, of the temperature and the daily range of pressure.

There seems to be a close connection between the above-mentioned pressure oscillations and the influence of the sun's prominences on the earth. Both coincide in relation to time. C. BRAAK.

Observatory, Batavia, January 11.

Electrons and Atomic Weights.

LOTHAR MEYER suggested that the slight divergences between the theoretical and actual atomic weights in the periodic system might be due to the imprisonment of a quantity of the æther within matter; Lord Kelvin ascribed to the æther a weight of one-thousand billionth of a gram per cubic meter. Meyer's suggestion is hardly acceptable.

In the light of present-day theories of the perpetual disintegration of matter, it seems more likely that the atomic weights vary through loss of electrons; when the loss has reached a certain critical point a re-adjustment may take place, resulting in transmutation to a lower element.

If there be any truth in this theory, it may be supposed that the atomic weights of the elements may vary in different worlds of space, the more or less uniform weights found on the earth being due to the fact that the period of formation was identical in all cases. In this connection, it would be interesting to determine the atomic weights of the elements in meteorites, an investigation which I am unable to undertake at this time, but which I hereby suggest. ALFRED SANG.

96 Boulevard de Versailles, St. Cloud, S. et O., January 12.

FURTHER ANTARCTIC RESULTS.[1]

THE Belgian Antarctic Expedition has issued another seven sections of the ten important volumes which it is contributing to Antarctic knowledge. Four of the new parts are technical contributions to systematic zoology. Prof. Jungersen, of Copenhagen, describes the Pennatulids, which are represented in the collection by eight specimens; all of them are referred to one species, the *Umbellula carpenteri,* first discovered by the *Challenger.* Herr Böhmig, of Graz, describes the Turbellarians, a small but interesting fauna containing a new genus of Acœla and three species of the characteristic sub-Antarctic genus Procerodes. A detailed account is given of the anatomy of these worms, and the author establishes a new genus and subfamily, the Stummerinæ, for a species that had been collected by the French Antarctic Expedition, and referred by Hallez to Procerodes. Herr L. Plate contributes a note on the Scaphopods, which are represented by one determinable and one indeterminable species of Dentalium, both collected south of latitude 70°. The Cirripedes are described by Herr P. P. C. Hoek, and this group is represented by three species, of which one, *Verruca mitra,* is new. They all come from the neighbourhood of the Magellan Straits. But that area does not appear to be rich in these crustacea, and the only known Antarctic species is a Scalpellum collected by the *Challenger* near the Antarctic Circle.

The geographical results include a valuable joint report by M. Arctowski and Dr. H. R. Mill on the serial temperature observations. Ross had attempted to determine the temperature of the deep sea in the same area, but, as is well known, his results were misleading, as his thermometers were not protected against pressure. The *Challenger* thermometers were, of course, guarded against this error, but they recorded only the temperatures of the coldest and warmest of the layers passed through during the sounding. Bruce, in the *Balaena,* was better equipped; but he was only able to determine the temperatures at two localities. The Belgian expedition, however, was able to conduct serial temperature soundings with such precision and in such numbers that the seas which it explored are, as regards temperature distribution, described by Dr. Mill as now one of the best-known parts of the oceans.

The observations show that the distribution of temperature in the seas between South America and Graham Land is typically sub-Antarctic. There is a zone of warm water between a cold surface layer and the mass of cold water below. South of the Antarctic Circle seasonal variations were found to affect the temperature to a depth of only 150 metres. In most localities the coldest water was found at the surface, and the temperatures rose, sometimes regularly, to a maximum in most cases at the depth of about 600 metres. Below that level there is a slow fall in temperature to the sea bottom. The bearing of these observations on submarine topography is shown in Gerlache Strait, where only one serial temperature observation was made; the temperature of the water was almost uniform throughout, and the water was a little colder at the bottom than at the surface. The authors, therefore, conclude that Gerlache Strait is a closed basin, and that a shallow threshold protects it from the inflow of warmer water.

FIG. 1.—Aiguilles of Cape Renard, seen from the North-east.

M. Lecointe, the second in command of the Belgian expedition, contributes a memoir on the pendulum observations. The frontispiece is a photograph of Lieutenant E. Danco, who had charge of this work until his death during the expedition. The memoir gives a detailed account of the instrument employed, Sterneck's half-second pendulum. It was only used during the expedition at one locality, Punta Arenas, in Tierra del Fuego, where the value of g was determined as 9·8108.

The new contribution to the reports of the Belgian expedition of widest general interest is M. Arctowski's valuable report on the glacial observations in the neighbourhood of Magellan's Straits and in the South Shetland Archipelago; and the glaciers and icebergs of those regions are illustrated by eighteen excellent photographic plates. M. Arctowski describes the former greater extension of the glaciers, and regards this as part of a world-wide phenomenon, for which he says the explanation has yet to be found. He adopts ex-

[1] "Résultats du Voyage du S.Y. *Belgica* en 1897–9." G. Lecointe, Physique du Globe, Mesures pendulaires, 1907. 40 pp., 9 figures; P. P. C. Hoek, Zoologie, Cirripedia, 1907, 9 pp., 4 figures; H. F. E. Jungersen, Zoologie, Pennatuliden, 1907, 12 pp., 1 plate; L. Böhmig, Zoologie, Turbellarien, 1908. 32 pp., 2 plates; L. Plate, Zoologie, Scaphopoden, 1908, 4 pp.; H. Arctowski and H. R. Mill, Océanographie, Relations thermiques, Rapport sur les Observations thermométriques faites aux Stations de Sondage, 1908, 36 pp., 4 plates; H. Arctowski, Géologie, Les Glaciers, Glaciers actuels et Vestiges de leur ancienne Extension, 1908, 74 pp., 18 plates (Anvers: D. E. Buschmann.)

"Deutsche Sudpolar Expedition, 1901–3." Edited by E von Drygalski. Vol. ii., Kartographie, Geologie; Part ii., 1908. pp. 91–222, plates ix–xxii., and 3 maps. (1) E. Werth, Aufbau und Gestaltung von Kerguelen, pp. 91–183, plates ix–xiv, 33 figures, 3 maps; (2) E. Philippi, Geologische Beobachtungen auf Kerguelen, pp. 185–207, plates xv–xxii, 2 figures; (3) R. Reinisch, Petrographische Beschreibung der Kerguelen-Gesteine, pp. 209–222, 6 figures. (Berlin: G. Reimer, 1908.)

Vol. i., Geographie, Heft ii. Pp. 99–280. Edited by E. von Drygalski. Vol. ii., Geographie, Geologie, part iii., 1908, pp. 223–298. plate xxiii. (1) E. von Drygalski, Geographie von Heard-Eiland, pp. 223–239, plate xxiii., 3 figures; (2) E. Philippi, Geologie der Heard-Insel, pp. 24 –250; (3) R. Reinisch, Gesteine der Heard-Insel, pp. 251–263, 8 figures; (4) E. Vanhöffen, Tiere und Pflanzen der Heard-Insel, pp. 265–271; (5) W. Meinardus, Skizze des Klimas der Heard-Insel, pp. 273–298, 2 figures.

treme views on some glacial questions, and holds that the progressive advance of civilisation to the temperate regions from the tropical and subtropical zones is one manifestation of the spread of a milder climate across the earth. Of the suggested theories of glaciation he regards Croll's as the most seductive, but admits that it has fallen with all the rest; nevertheless, he still argues with Croll's wild estimate that the ice at the South Pole is six miles thick, as if that notion were worth serious consideration. Arrhenius's view that glaciation is due to variations in the atmosphere Arctowski rejects as being far from a satisfactory explanation of the facts. His own idea is that the climatic change was due to a variation in the heat supply from the sun.

The memoir begins with a description of the glacial phenomena of the neighbourhood of the Magellan Straits, supplementing the valuable observations in this area by Dr. Otto Nordenskjöld. The second part of the memoir is a valuable contribution to the tectonic and glacial geology of Gerlache Strait. He describes that strait as a tectonic valley, but he is doubtful (p. 34) whether it was formed as a syncline or a rift valley. In dealing with the Antarctic lands, he notes the various forms of the name Antarctica, and suggests that the western section should be called "Westantar," as "Antar" includes all that is common in the various forms of the name Antarctica.

Fig. 2.—View of Royal Sound, Kerguelen.

In his account of the tabular icebergs, M. Arctowski is emphatic as to their identity with the floebergs of the Arctic, and he quotes with approval Greeley's excellent statement of the formation of floebergs. He discusses the question of glacial erosion, and says that his observations show that erosion by glaciers is a mere "minime"; but he remarks that ice has powers of deeper erosion than rivers, as it can erode below sea-level, whereas a river cannot excavate deeper than the level of its mouth. His report concludes with an interesting discussion on the extent of the refrigeration of climate indicated, according to the theory he accepts, by the former extension of glaciers.

A further instalment of the reports of the German Antarctic Expedition includes three instructive memoirs on Kerguelen. Dr. Werth records his additions to the geography of the island during a year's residence, in 1901 and 1902, at a station erected on the Gauss Peninsula in south-eastern Kerguelen to obtain observations for comparison with those simultaneously made by the *Gauss*. Emil Philippi, the geologist of the expedition, records the results of his excursions ashore during the stay of the *Gauss* at Kerguelen, and Dr. Reinisch describes in detail the rock specimens collected there.

Since the discovery of the archipelago by Kerguelen in 1772, and the establishment of its insular nature by Cook in 1775, it has been visited by many expeditions, including the *Erebus* and *Terror*, the *Challenger*, the *Gazelle* and the *Valdivia*, and by private naturalists, such as Hall, the Australian ornithologist. It has also been the resort of seal and whale fishers. Nevertheless, and in spite of the important contributions of the expedition under Drygalski, Kerguelen is still imperfectly known. Dr. Werth made numerous excursions from the station, but the main interior and its glaciers and mountains, were inaccessible to him, and the southern and western coasts he describes as still practically unknown. Dr. Werth's range of work was restricted by the difficulties of transport. His party had at first to carry all their equipment on their backs, and were therefore limited to excursions of about five days' duration. Later on he used dogs, and as each dog carried a pack of twenty pounds, it could take its own rations for ten days, and some supplies for the explorers. In the later part of the stay on the island exploration was unfortunately prevented by illness.

The chief island of the Kerguelen Archipelago is only 130 square geographical miles, and it is divided into three divisions. The western coast lands are still little known, and may contain some centres of recent volcanic activity. The central highlands, running from north-west to south-east across the island, include two high ice-covered plateaus, and culminate at their southern end in Mount Ross, a volcano with a well-preserved crater and 1990 metres high. The third section includes the country on the eastern parts of the island; it is deeply indented by the sea, and is mainly lowland, but it includes one independent mountain complex and some wide plateaus.

The solid geology of Kerguelen is disappointing. It consists of nothing but a vast dissected sheet of basalts, with their associated tuffs, and various glacial and alluvial deposits. There are older trachytic and phonolitic lavas, of which the German expedition obtained traces in beds of sanidine sand. There are no known pre-volcanic sedimentary rocks, and whether Kerguelen is a continental or an oceanic island is left undecided. The physical geography of the island is, therefore, its chief interest. For a land in the latitude of only 48°–50°, it has the remarkably low snow-line of 1850 feet, and its central highlands are covered by an ice sheet which Dr. Werth has named after Richthofen. There is abundant evidence that the glaciers were more extensive, at a date that Dr. Werth calls "diluvial," which may be more recent than the chief glacier extension in north temperate regions. The glaciers certainly formerly reached the present sea-level, and appear to have continued some distance over what is now the sea floor. It is, therefore, disappointing that there is no certain evidence as to the post-Glacial

uplift of the land. Both Werth and Philippi describe the occurrence of recent shingle and shells at heights up to about one hundred metres; but they recognise the possibility of these having been carried inland by sea-gulls or sea elephants. There is abundant evidence of recent subsidence; the eastern district, according to the chart and many beautiful photographs, presents the typical features of a sunken land.

Dr. Werth discusses at length the origin of the valleys and the relations of the two types of drowned valleys known as "fjords" and "fjärds." The distinction between them was established by Penck in 1882; fiords are complex and usually branched valleys in mountainous districts, and fjärds are valleys that are usually parallel to one another, and occur in lowlands. The value of this distinction has been doubted, but Werth thinks it is useful; and he proposes that valleys of the fjärd type should be called "föhrde," after the name given them in southern Denmark, as it has the same root as the Norwegian fjörd, the Swedish fjärd, the Icelandic fjördur, and the Scottish firth.

Denudation in Kerguelen, according to Dr. Werth, is due chiefly to glacial action, for the rivers are insignificant; but Philippi points out that the valleys were pre-Glacial. Consideration of their age necessarily involves that of the lava flows through which they have been cut. In the neighbourhood of the station the eruptions were obviously pre-Glacial; but the crater of Mount Ross must be much younger than the lava flows of the eastern lowlands. The only palæontological evidence of the age of the eruptions is given by some fragments of the stem of Cupressoxylon; but as this conifer ranges from the Upper Cretaceous to the Pliocene, its evidence is not very precise, though the Kerguelen species is regarded as pre-Pleistocene. Wind erosion is exceptionally well exhibited, owing to the violence of the storms and the abundance of loose volcanic débris for the sand blast; the effect of the wind is illustrated by photographs of a carved block of basalt and of some potholes bored by sand erosion on the face of a vertical rock.

The important contributions of the German expeditions to the natural history of Kerguelen show how great are the gaps in our knowledge of that interesting and accessible archipelago, and will, it may be hoped, lead to its fuller investigation.

Heard Island, where the German Expedition spent seven profitable hours ashore, is 330 miles south-east of Kerguelen, and is even less known. Both islands rise from the same submarine plateau, and the reports by Philippi and Reinisch show that they are composed of similar volcanic rocks, for Heard island consists of trachytes, felspar basalts and limburgites. The rocks look less weathered than those of Kerguelen, but Philippi suggests, from the greater abundance of trachyte, that the lavas belong to the earlier period of the Kerguelen eruptions. Prof. Drygalski describes the geography of Heard Island and the seven glaciers on the northern coast, Meinardus contributes a sketch of its climate based on all existing records, with the gaps filled by interpolation from the observations on the *Gauss* and at the station at Kerguelen. In view of the many interesting problems connected with Heard Island, Prof. Drygalski recommends it as a suitable locality for a year's expedition; and as at the visit of the *Challenger* there were forty men on the island who were staying there from October to December, an expedition should be easily practicable and profitable.

J. W. GREGORY.

IRRIGATION IN EGYPT.

The Esneh Dam.

THE construction of the dam on the Nile near Esneh, which has recently been completed, the last stone being laid by the Khedive, marks another step in the progress of that country since it has been under British control. Less than thirty years ago Egypt was on the verge of financial ruin, the annual expenses exceeding the income, and there not being sufficient revenue to pay the interest on the national debt. The peasantry were in a miserable and poverty-stricken condition, and constantly harassed by the continuous calls under the labour conscription, or *corvée,* for the repairs of the banks or the cleansing of the irrigation canals. This system has now been entirely done away with; the small farmers are no longer at the mercy of the money-lender, and are in a prosperous and contented condition. The revenue shows a surplus, and the yield of the crops has been enormously increased.

The leading factor in this change has been the better and more effective management, and the extension of the irrigation works, on which the agriculture of Egypt depends for its existence.

The cultivated portion of Egypt consists of a narrow strip of land bordering on the Nile, extending southward from the Mediterranean Sea. Of this the lower, or southern, district consists of the delta of the Nile below Cairo, forming a triangle, the sides of which are about 100 miles in length, with an area of four million acres, the cultivated portion of which covers $2\frac{3}{4}$ million acres. At the head of this delta the Nile water is held up by the great barrages of Rosetta and Damietta. Above this is Upper Egypt, a tract 500 miles long, lying principally on the west side of the river, and extending nearly to the first cataract above Assouan. The width of the land that is cultivated varies from eight to fourteen miles, the sand of the desert in many places at the upper end reaching close up to the river. The area of the land under cultivation is about $2\frac{1}{2}$ million acres, which is dependent entirely on irrigation. Rainfall in Egypt may be said to be conspicuous by its absence, the average fall at the northern end being $1\frac{1}{2}$ inches, and above this the country is practically rainless.

The Nile is one of the longest rivers in the world, its length from the source to the Mediterranean being more than 3000 miles. Owing to its physical conditions, the fact that it has no tributaries for the last 1500 miles of its course, and the great amount of evaporation under the tropical heat of the sun, it presents the peculiar phenomenon that the quantity of water flowing down the river decreases as the lower length of its course is reached. In floods it carries in suspension detritus derived principally from the volcanic plateau in Abyssinia and the swampy regions of the White Nile. The quantity of material thus transported from the middle of Africa and Abyssinia has been estimated at 62 millions of tons a year, raising the level of the cultivated land in Egypt at the rate of $3\frac{1}{2}$ inches in a century, and to a depth which in some places extends to 30 feet.

The Nile being fed from lands having wet and dry seasons, it has a regular rise and fall, the water through Egypt being at its lowest in June and reaching its maximum in October. The reading of the Nilometer at Rodah is watched with the greatest interest, as the prosperity of the country depends on the height of the flood water. The difference between high and low floods varies about $10\frac{1}{2}$ feet, the mean rise varying from 23 feet at Cairo to 26 feet at Assouan at the upper end. The discharge of this

flood water being greater than is required at high floods and deficient in low floods and in summer, a system of dams at different parts of the river has been carried out for storing and regulating the supply.

The principal crops grown along the Nile are wheat, sugar, cotton, rice, maize, and other smaller vegetation. Where the supply of water is sufficient, two crops can be obtained in one year. The cultivation of cotton is rapidly extending, the value of this crop alone now being nearly as great as the whole revenue of the country.

The first great work for improving the irrigation undertaken by the Works Department after the British obtained control in 1883 was the completion of the great barrage, or dam, at the head of the Delta. This had been constructed by the French engineers for the purpose of holding up the Nile water to a height of 15 feet, sufficient to provide the necessary head for feeding the irrigation canals. Owing, however, to defects in the construction, it had never been possible to raise the level more than 5 feet. Under the direction of Colonel Scott-Moncrieff, the foundations were strengthened, and other necessary repairs carried out, with the result that the full head of water can now be maintained, and the land can be efficiently irrigated. Also, by the construction of another barrage, at a cost of 230,000*l.*, half-way between Cairo and the sea, the irrigation is rendered still more effective. Owing to these works the value of the cotton crop has been increased from 7½ to 15 millions of pounds, and the cultivated area increased by a million acres.

For regulating the supply of water in Upper Egypt, about seven years ago the great barrages, or dams, at Assouan and Assiout were built across the river at the head of the cultivated system of Upper Egypt. These works were carried out by the firm of Aird and Co. for the English Irrigation Department, the contract price being 2,000,000*l.* These dams act as regulators of the water supply in summer, and have practically doubled the supply available. It was stated by Lord Cromer, in one of his reports soon after they were completed, that the effect of these works was to increase the rental of the land to 3*l.* an acre, in addition to a tax of 10*s.* that is levied to pay the cost. A practical demonstration of their value was afforded in 1902, when the Nile flood was a very poor one, and the agricultural outlook was very critical, for a large area of cropping was in danger of being entirely lost through want of irrigation. This, however, was prevented, owing to the water stored by the dam at Assiout, and cropping estimated of the value of 500,000*l.* was saved. Thus the whole cost of this dam was paid for in this one season.

The dam recently opened by the Khedive is near Esneh, a town of 25,000 inhabitants, situated on the Nile 643 miles from the Mediterranean and 110 miles below the dam at Assouan. It has been constructed for the purpose of storing the flood water and providing perennial irrigation to a tract of land containing 250,000 acres, on which at present only one crop of cereals can be grown. When irrigated this land will be capable also of growing a second, or summer, and more profitable crop of sugar or cotton.

The dam is somewhat similar in construction to those above described. It consists of a masonry structure containing 119 piers, spaced 16½ feet apart, and connected by arches, on which is carried a roadway across the Nile about half a mile long and 19½ feet wide. The openings between the piers are fitted with upper and lower doors, or gates, resting in grooves, which can be raised or lowered by machinery so as to regulate the discharge of the water through the dam. For the use of the navigation a lock has been provided which is 262½ feet long and 52½ feet wide.

The dam at Assouan rested on the granite bed of the river, but at Esneh the substratum was sand, which extended to a considerable depth below the bed of the river. To carry the structure, therefore, a continuous floor had to be made 2950 feet long and 98½ feet wide. This floor consists of cement concrete 3½ feet thick, on which is 6½ feet of rubble masonry laid in cement and paved with granite setts. To prevent the water finding its way under this floor, when it is held up, two rows of iron sheet piles were driven to a depth of 13 feet below it, 61½ feet apart, across the bed of the river, the space between being filled with clay puddle pitched with limestone. On the down-stream side, to prevent erosion of the river bed by the water pouring through the arches when the doors are open, a floor was laid with a pitching of limestone 131 feet wide.

The superstructure was built of sandstone, granite being used for the lock. This sandstone was obtained from a quarry fifty-seven miles distant, the quantity used amounting to 166,000 cubic yards. The granite, of which 80,000 cubic yards was used, was brought down the Nile in barges from Assouan, a distance of 110 miles. The cement, the iron piles, and the machinery all came from England.

From 8000 to 10,000 natives were employed, Italians being engaged in preparing the stone. The work was supervised by English foremen and overseers.

The preliminary works, including the opening out of the quarries, temporary railways, of which twenty-four miles were used, workshops for the men, and offices, were commenced in the spring of 1906, the permanent work being begun in the following November. Three years were allowed by the contract, and as the work was completed in half the specified time, the district is thus given the benefit of an extra season's irrigation.

The works were designed by Mr. Webb, the engineer of the Egyptian Works Department, under the direction of Mr. Macdonald, the director of reservoirs, and carried out by Messrs. Aird and Co., the same contractors who constructed the Assouan and Assiout dams. The cost was more than 1,000,000*l.*

ELECTROCHEMICAL INDUSTRY.

THE report referred to below[1] is based in the main on information obtained during visits to certain countries in Europe and to the United States and Canada, including British Columbia. The Gartside scholarships were established in 1902 by Mr. J. H. Gartside, and are administered by the University of Manchester. The scholar who obtains the grant must first study in the university, and the remainder of his time must be devoted to an examination of subjects bearing upon commerce or industry in Germany, Switzerland, or the United States of America. It is intended that each scholar shall select some industry or business for examination, and investigate this comparatively in the United Kingdom and abroad.

The report is of particular interest because it deals with a subject which is of comparatively recent growth, and which has remarkable potentialities. In fact, as the author says, few chemical processes have escaped being affected in a greater or less degree by the application of electrical methods.

[1] "Some Electrochemical Centres." By J. N. Pring. Being No. 7 of the Gartside Reports on Industry and Commerce. Pp. xiii+137. (Manchester: University Press, 1908.) Price 1*s.* 6*d.* net.

But in this country no revolution has been caused in the chemical industry by the introduction of electrochemical methods. Of course, there are various reasons for this; in the first place, cheap power is a *sine qua non* if an electrochemical process is to be satisfactory. Although we have cheap coal, we have very limited supplies of water power. The heavy chemical industry of this country was also in a very secure and flourishing state, therefore there was not much inducement to try the newer methods. On the contrary, in America the chemical industries were not particularly well established. The water power obtainable from the Niagara is immense, although in this connection it should be borne in mind that nearly all the large electrolytic copper refineries are situated near New York, and are worked by steam power; and the progress in America is due in no small measure to the great enterprise and *superior technical training* of the people.

The first part of the volume discusses the question of cost of power production, comparisons being made between water, steam, oil-engine and gas-engine power. It appears in general that water power is the most economical, and gas engines actuated with blast-furnace gas the next. Chapter ii. deals with the Niagara Falls and the distribution of the power, the chief industries being the Aluminium Co. of America, Carborundum Co., Union Carbide Co., Castner Kellner Electrolytic Alkali Co., Oldbury Electrochemical Co., Acheson Graphite Co., and Niagara Electrochemical Co., which take between them about 68,500 h.p. One of the most interesting industries which entirely owes its origin to electrical power is the manufacture of abrasives—carborundum and alundum. There is also the flourishing artificial graphite works. The aluminium works employ about 35,000 h.p., and hold practically the monopoly of the aluminium manufacture in the U.S.A. and Canada. A large part of the power developed from the Niagara is employed for electrochemical purposes on the Canadian side of the falls.

The descriptions of the power obtained from the various falls and rapids is narrated in a very interesting manner. Chapter v. treats of the electric smelting of iron ores and steel production. The electrochemical industries in the Alps, France, and Belgium are also dealt with. In the Alps there are a large number of comparatively small falls, and it says a great deal for the skill of the French engineers that so much use has been made of them, rendering France the chief seat of the electric alloy manufacture. The last chapter describes the electrochemical industries in Great Britain, and anyone reading the book will probably find that there is more work being done in this direction than is generally considered to be the case. The origin of the electrolytic refining of copper was in this country, where it was founded in 1869 by J. Elkington, and the works erected at Pembury, in Wales, are still in operation, although, naturally, they have been enlarged. We congratulate the author upon a very readable and painstaking production.

F. M. P.

NOTES.

We regret to announce the death, on February 13, of Sir George King, K.C.I.E., F.R.S., late director of the Botanical Survey of India, in his sixty-ninth year; also of Prof. Julius Thomsen, president of the Royal Danish Society of Science, at eighty-two years of age.

A Reuter message from Washington states that the Smithsonian Institution has decided to award the first Langley gold medal to Messrs. Wilbur and Orville Wright.

The Berlin Academy of Sciences has awarded the Helmholtz medal to Prof. Emil Fischer, for his work on the sugars and albuminoids.

It is announced that an international exhibition is to be held at Brescia from August to October next under the patronage of the King of Italy.

The Prehistoric Society of France has elected Dr. A. Guebhard president for 1909; MM. Marot and Viré become vice-presidents, Dr. Marcel Baudouin general secretary, and M. L. Giraux treasurer.

The *Petit Journal* recently asked its readers to select by their votes twelve great Frenchmen worthy of being included in the Pantheon. Pasteur's name appeared at the top of the poll with 315,203 votes, and was followed by that of Gambetta with 279,443 votes. We wonder whether a man of science would head the list if a similar plebiscite were taken by a popular daily paper in this country.

The proposed amalgamation of the London Institution with the Society of Arts on the lines of a scheme drawn up by a joint committee in 1905 has been approved by a majority of the proprietors of the former institution. A ballot taken on Monday showed as the result:—for amalgamation, 322; against, 218, the majority in favour thus being 104. The board of management has now to consider whether action shall be taken to carry out the scheme for amalgamation.

The council of the Royal Society of Arts attended at Marlborough House on February 11, when the Prince of Wales, president of the society, presented its Albert medal to Sir James Dewar, F.R.S., "for his investigations into the liquefaction of gases and the properties of matter at low temperatures, investigations which have resulted in the production of the lowest temperatures yet reached, the use of vacuum vessels for thermal isolation, and the application of cooled charcoal to the separation of gaseous mixtures and to the production of high vacua."

At the annual meeting of the Royal Astronomical Society on February 12, the following were elected as the officers and council for the ensuing year:—*President*, Sir David Gill, K.C.B., F.R.S.; *vice-presidents*, Sir W. H. M. Christie, K.C.B., F.R.S., Dr. J. W. L. Glaisher, F.R.S., Mr. H. F. Newall, F.R.S., Prof. H. H. Turner, F.R.S.; *treasurer*, Major E. H. Hills, C.M.G.; *secretaries*, Mr. A. R. Hinks, Mr. S. A. Saunder; *foreign secretary*, Sir William Huggins, K.C.B., O.M., F.R.S.; *council*, Mr. Bryan Cookson, Rev. A. L. Cortie, Mr. A. C. D. Crommelin, Mr. A. S. Eddington, Prof. A. Fowler, Mr. J. A. Hardcastle, Mr. H. P. Hollis, Mr. E. B. Knobel, Mr. T. Lewis, Major P. A. MacMahon, F.R.S., Mr. W. H. Maw, Prof. R. A. Sampson, F.R.S.

Severe earthquake shocks were experienced again at Messina and in Calabria on February 12 and 13. The *Daily Chronicle* Milan correspondent reports the chief shock as occurring on February 13 at 8 p.m., and lasting for ten seconds, the shock being accompanied by noises like that of cannon during a heavy bombardment. A Reuter's message from St. Petersburg states that a slight earthquake shock was felt on February 13, at 8 a.m., at Sotchi, in the Government of Suchum. Another message from Mexico City reports that the volcano of Colima, near the town of that name, was erupting with increasing violence on February 13. Loud subterranean detonations were heard, and showers of hot ashes fell. A stream of

lava a mile long is said to have been emitted from the crater. On February 16 severe earthquake shocks were felt in southern Bulgaria and parts of Hungary.

THE Prince and Princess of Wales were present at the Royal College of Surgeons on Monday, when Mr. Henry Morris, the president, delivered the Hunterian oration, taking as his subject "John Hunter as a Philosopher." The Prince has accepted the diploma of honorary fellow of the college, and on Monday he signed the roll. The president, in the course of his address, said a study of Hunter's works shows that he combined in an exceptional degree the two philosophic methods of induction and deduction. He was essentially a thinker rather than a scholar, yet an experimental philosopher rather than a metaphysician. He saw that for a complete scheme of knowledge induction and deduction are supplementary to each other. His adoption of both inductive and deductive methods was the result of two causes—the natural scope and bent of his mind and the nature of the subjects to which he devoted his life. Induction was largely the method required for the profession he chose. Hunter was a disciple of Bacon in that he employed induction in the pursuit of truth with an ulterior regard to utility and the good of mankind. At the same time he had not the deductive force of Descartes. It was not as a logician, but as an observer and experimenter that Hunter excelled; it was not the beauty of his logic, but the industry with which he collected facts, and the ability and honesty with which he reasoned from them, that made him great.

IT is announced in *Science* that Mr. D. C. Sowers, in charge of the special magnetic expedition to China under the auspices of the Carnegie Institution of Washington, left Peking on January 30. He will be assisted by Prof. Chester G. Fuson, professor of history and geography at the Canton Christian College. The route to be followed by the party will touch at the following places:—Sianfu, Lanchowfu, Suchow, Turfan, Kashgar, Khotan, thence, *viâ* the Karakorum Pass, into India, where connection will be made at Dehra Dun with the magnetic survey of India. Magnetic observations will, therefore, be obtained in parts of China and Chinese Turkestan where no previous data existed. Dr. J. C. Beattie, director of the department of physics, South African College, Cape Town, has been granted a year's furlough in order to take charge of a magnetic survey party under the auspices of the Carnegie Institution. He left Cape Town on November 25 last. His general route of travel will be through German South-West Africa, thence into Rhodesia, British East Africa, German East Africa, and next through Nubia and Egypt, connecting with the magnetic survey of Egypt at Cairo. He will be assisted by Prof. J. T. Morrison, in charge of the department of physics, Victoria College, Stellenbosch, South Africa, who will confine his work chiefly to points reached by steamer along the east and west coasts of Africa. Mr. J. C. Pearson, who during the past year has been engaged in making magnetic observations in various parts of Persia under the auspices of the Carnegie Institution, will be ready some time in March to undertake similar work in Asia Minor, beginning at Bagdad.

MESSRS. H. W. COX AND CO., LTD., of 47 Gray's Inn Road, London, W.C., point out in a circular letter that the exaggerated reports which have appeared consequent upon the sufferings of some of the earliest workers with Röntgen rays (including Mr. Cox himself) have affected not only the English manufacturer and the medical man who were sufficiently enterprising to take up the new treatment, but also to a considerable extent deprived the public of the benefit of the discovery which has been of such incalculable value in the relief of suffering and the advancement of medical knowledge. It should now be well known, however, that apparatus has been devised which entirely obviates any danger either to the patient or to the operator, while experiments have determined the maximum exposure which may be given with safety to the human skin. The rays are now used with perfect safety in thousands of hospitals throughout the world in the treatment of various diseases. Mr. Mackenzie Davidson long ago exhibited at the Röntgen Society the method of protection from the injurious effects of X-rays advised by him. It simply consisted of a wooden box thickly coated with red and white lead mixed into a thick paste—this hardened, and was a non-conductor. A circular opening was left opposite the antikathode. Thus everyone was protected from these rays except the patient who was placed in the path of the rays. Further, the viewing fluorescent screen should be framed and covered with thick and heavy plate glass, which does not interfere with the screen except to protect it (as the glass does a framed picture), and shields the observer from injurious rays. Had these simple precautions been carried out, we should not be grieved by these maimed martyrs. Of course, any material of sufficient atomic weight can be used to enclose the X-ray tube.

A COPY of the annual report for the year 1908 of the council of the Philosophical Institute of Canterbury, N.Z., has been received. During the year arrangements have been under consideration for the publication of the report of the expedition to the subantarctic islands of New Zealand, which took place in 1907 under the auspices of the institute. The expedition was assisted by the Government, and 500*l*. was received from the same source towards bringing out the report on the expedition. Other important questions which have occupied the attention of the council include experiments in connection with Arthur's Pass Tunnel, the foundation of a library of Antarctic literature, the dispatch of a scientific party to the Chatham Islands, and the more adequate protection of native fauna. The Government of the Dominion of New Zealand has made a grant of 200*l*. towards the earth-temperature observations at Arthur's Pass Tunnel, and we notice the council puts on record its indebtedness to Prof. Heim, of Zürich, for the help and advice he has rendered the subcommittee in charge of these experiments. The council recommends that a party of men of science be sent at the first opportunity to the Chatham Islands to make collections of articles of ethnological interest and of specimens of the subfossil bird remains. In connection with the protection of native fauna, it has been decided to direct the attention of the Minister of the Interior to the fact that neither the kaka nor the tuatara is protected, though the export of specimens of the latter is forbidden.

THE Journal of the Royal Sanitary Institute for February (xxx., No. 1) contains a valuable paper by Dr. Rideal on the purification of water by ozone by the De Frise process, which is considered to give extremely satisfactory results.

IN the Bulletin of the Johns Hopkins Hospital for January (xx., No. 214) another paper on the history of medicine is added to the series already published in this journal, the subject being John James Wepfer, a Renaissance student of apoplexy, contributed by Dr. John Donley.

THE Royal Commission on Tuberculosis recently issued a third interim report (Cd. 4483, price 4*d*.). In their second interim report the commissioners expressed the

opinion that a considerable amount of disease and loss of life, especially among infants and children, must be attributed to the consumption of cows' milk derived from tuberculous udders and containing tubercle bacilli. The present report contains an account of experiments which have been carried on regarding the infectivity of the milk and fæces of cows which have contracted the disease in the ordinary way. None of the cows investigated showed any sign of tuberculosis of the udder during life, and one only *post-mortem*, yet the milk of these cows contained tubercle bacilli. It was also found that cows affected even with slight tuberculous lesions discharge tubercle bacilli in small numbers in the fæces; those with extensive tuberculous lesions of the lungs or alimentary tract may discharge large numbers of bacilli from the mouth or nostrils in coughing or in the fæces. Since dirt of various kinds from the cow-sheds is almost constantly present in milk as it reaches the consumer, another possible mode of human infection is indicated.

THE greater part of the January issue of the *Museums' Journal* is occupied by papers on the Norwich Museum Association and on a new method of keeping Lepidoptera, both of which were read last year at the Ipswich conference. The system of keeping butterflies and moths, which Mr. S. L. Mosley claims to possess great advantages, is based on devoting a separate box—made in book-form—to each species, with all its phases and variations, as well as illustrations of its natural surroundings and maps of its distribution. The boxes can be arranged on shelves like books.

PROF. RINA MONTI, writing in the Lombardy *Rendiconti*, xli., 18, discusses the active and passive migrations of the fauna of the Italian Alpine lakes. The author finds that on the south side of the Alps the migrations from valley to mountain should have been less easy at the end of the Glacial epoch than at present, on account of certain geohydrographical considerations which he has examined. The passage of boreal types from north to south must necessarily have taken place through depressions in the dividing chain, and the author advances arguments against the hypothesis of an active migration. In several lakes of recent origin of the Ruitor, formed by the regression of glaciers, the author finds that the fauna have migrated from neighbouring basins.

THE whole of the first part, comprising 170 pages of text and twenty-four plates, of the fifth volume of the Zoological Publications of the University of California is devoted to the results of a biological survey, by Mr. Joseph Grinnel, of the San Bernadino Mountains of southern California. These mountains, in the restricted sense of the term, form the most extensive high range in the south of California, and include the highest peak to the south of Mount Whitney. As a large portion is clothed with forest, while the range is isolated from any other mountain-group of approximately similar altitude, the area is one which might naturally be expected to yield results of considerable biological interest. The author paid particular attention to the division of the range into vertical life-zones, which include the Upper and Lower Sonoran, the Transitional, and the Boreal. It was found, as might have been expected, that the flora afforded by far the better data for the delimitation of these zones. Among the special features in the habits of the fauna is the fact that the birds which have bred in the spring and early summer at comparatively low levels are compelled in July to move higher up the mountains in order to escape the shortage of food which prevails, owing to the drought, in their breeding haunts from the commencement of that month until the end of October. A remarkable mortality among the Audubon's warblers was also noticed in December and January; as all these were in an emaciated condition, the lack of proper food would appear to be the cause of the deaths.

DOES the kidney form an internal secretion? is a question upon which physiologists are uncertain. It is stated that extracts of kidney tissue produce a rise of blood pressure; but the main experiments relied upon by those who answer the question in the affirmative were performed some years ago by Dr. J. Rose Bradford, in which he showed that, after removal of a large amount of kidney tissue (the whole of one kidney and a considerable piece of the other), dogs exhibit symptoms of malnutrition which cannot be explained by the loss of the external secretion, the urine. Indeed, the volume of the urine, and the amount of urea excreted, are very frequently higher than the normal in such animals. These experiments were repeated by Bainbridge and Beddard at Guy's Hospital on cats, and their findings did not confirm the far-reaching conclusions which were drawn from Bradford's experiments. The symptoms of malnutrition, according to these later observers, are simply those ordinarily found in inanition, and this condition was present in the cats owing to their refusal to take food. Very similar experiments have just been performed by two American observers, Drs. Sampson and Pearce (*Journal of Experimental Medicine*, New York, vol. x., No. 6, November, 1908). They show that in dogs a reduction of the kidney tissue to one-quarter the original amount is not necessarily fatal, and this is a very important discovery in view of the frequency of surgical operations on the kidney. Very extensive removal of pieces of the kidney is followed by rapid healing, and very little effect on the remaining kidney tissue is noticeable. In cases where a fatal termination did take place, there was renal insufficiency, and the animal refused food. The general trend of the results is therefore in favour of the views of Beddard and Bainbridge.

IN the *Contemporary Review* for February Dr. Havelock Ellis discusses the evolution of the feeling of love of wild nature, that is to say, scenery from which man is excluded. He finds the germ of it in the conception of mingled love and horror felt by the savage towards mountain and woodland, the one the natural home of his gods, the other the abode of malevolent spirits. The affection of his votaries for a god of the wild, like Apollo of Delphi, might in process of time extend to his chosen seat. In Europe the love of scenery first appears among the Celts towards the western isles of Scotland. In classical times the charming, luxuriant landscape of Italy was more fitted to win the admiration of men than the terrible and dramatic aspects of Greece. This became more apparent in the days of the Empire, when Nero chose Subiaco as his abode, and Marcus Aurelius retired for meditation to mountain or sea. Early Christian literature shows little sense of this feeling, but the hermits, who in a state of religious exaltation fled to the desert, fostered at least a tolerance of their barren surroundings. The Christians, again, took over from paganism many sites consecrated to the worship of the gods on account of the remarkable character or beauty of their situation, and religious orders, like the monks of the Grand Chartreuse, were obliged to accept grants of barren lands worthless to their owners. The modern taste for wild scenery was the offspring of the Italian Renaissance, which only revived the views of earlier writers, like the younger Pliny. Coming to more modern days, Addison

shows an advancing but still incomplete appreciation of Alpine scenery, which was further developed by the solitary, imaginative Gray. It was left to Rousseau, in "La Nouvelle Heloise," to popularise that feeling in Europe, the tradition of which passed on to Wordsworth, Byron, and their many successors. While, then, it is incorrect to regard the love of wild nature as an almost universal human instinct, there is evidence that it was felt by the more imaginative minds from the very earliest times.

MR. D. GRIFFITHS contributes to the annual report of the Missouri Botanical Gardens (vol. xix.) a first series of illustrated studies on the genus Opuntia that acquires additional interest because the plants have been studied in their natural localities. Types of several new species, chiefly Mexican, are described.

WITH the present issue, for February, *Irish Gardening* completes its third year, and may well claim to have fulfilled its purpose of providing a source of information for Irish cultivators. An article of general interest to cultivators of rock gardens, on the subject of suitable dwarf shrubs, is contributed by Mr. J. W. Besant. Attractive colouring of leaves, flowers or fruit, in addition to dwarf habit, are the qualities recommended. The author presents a selection of species from about ten genera, among which *Berberis Wilsonae*, a new introduction from China, *Cotoneaster adpressa*, varieties of *Euonymus radicans*, *Genista tinctoria*, *Hypericum moserianum*, *Potentilla Friedrichsoni*, and *Perovskia atriplicifolia* receive special commendation.

MR. G. A. NADSON contributes to the *Bulletin du Jardin impérial botanique*, St. Petersburg (vol. viii., parts v. and vi.), a short article on the physiology of luminous bacteria, regarding the action of salt in cultural media. Luminosity is produced quickly by using a strong solution containing about 3 per cent. of salt, but a solution containing one-half per cent. eventually produces a more intense light. The following method for obtaining the spores of *Saccharomyces cerevisiae* is recommended by Mr. A. A. Gorodkowa. Sowings of pure yeast are made on plates of agar prepared from a solution containing 1 per cent. each of agar, peptone, and meat extract, a half per cent. of salt, and a quarter per cent. of glucose. The cultures, placed in a thermostat maintained at a temperature of 28° C., should produce spores in three or four days.

ON the question of sense-organs in plants, botanists are primarily indebted to Prof. Haberlandt and Dr. Nemec for original conceptions that have met with considerable, but not universal, acceptation. Arising out of a lecture delivered in Berlin, Prof. Haberlandt has published an article on the subject in *Himmel und Erde* (December, 1908, January, 1909). Three different classes of sense-organs are described, concerned respectively with the perception of mechanical, gravitational, and heliotropic stimuli. The arrangement, in the first case, often consists of a projecting cell or portion of a cell, as in the stamens of *Portulaca grandiflora*; more remarkable is the staminal filament of *Sparmannia africana*, that is notched on the receptive side. The theory that starch grains act as mechanical regulators of gravitational stimulation has aroused much criticism, but has been put to a convincing experimental test by Dr. Francis Darwin. Finally, Prof. Haberlandt submits the arguments in favour of regarding lens-shaped epidermal cells and similar structures in the leaves as apparatus for concentrating the light on the protoplasm, and so regulating the position of the leaf.

THE December (1908) number of the *Journal of Agriculture of South Australia* contains the official estimate of the probable wheat harvest for 1908–9 in South Australia. The total yield is placed at just under 20 million bushels, an average of 11·6 bushels per acre. The corresponding actual figures for last year were a little more than 19 million bushels, with an average of 10·9 bushels per acre. The total area under wheat is estimated at 2,062,000 acres, an increase of 37,000 acres over the previous year, but some of this is grown as a hay crop. The area reaped for grain is placed at 1,727,000 acres, a decrease of 26,000 acres; the area cut for hay is 334,000 acres, an increase of 63,000 acres.

THE report on the Botanic Station, Agricultural School, and Experiment Plots of St. Lucia, recently issued by the Imperial Commissioner of Agriculture for the West Indies, shows satisfactory progress. A large number of economic plants have been raised, and nearly 75,000 were distributed, including lime plants, which were most in request, cacao, rubber, the demand for which fell off, mangoes, oranges, &c. Experiments are recorded on cultivation and spraying; it was found that lime trees could be sprayed with an emulsion of kerosene sufficiently strong to destroy the orange snow scale (*Chionaspis citri*) without themselves suffering any harm.

THE varieties of potatoes grown in the Central Provinces of India are described by Mr. G. Evans in a bulletin issued by the Department of Agriculture for the Central Provinces. Until four or five years ago the Moolki variety was the only one grown in certain districts, and there is evidence to show that it had been grown for nearly 100 years without change of seed or climate; it is now, however, said to be "worn out," and rapidly succumbing to attacks of disease, &c. Potatoes are not uncommonly displacing sugar-canes, and are found to be more profitable.

IN vol. xxiii. of the *Queensland Geographical Journal* Mr. H. R. Mathews, without any reference to, and apparently quite independently of, the papers by Mr. N. W. Thomas in vols. xxxv. and xxxvi. of the Journal of the Royal Anthropological Institute, discusses the methods of navigation among the aborigines of Australia. He dismisses the catamarans and dug-outs used in Cape York Peninsula, Port Darwin, and other northern parts of the continent because he refuses to admit that they are of Australian origin, and attributes the introduction of these types to Malays or Papuans, the former race being probably responsible for the more elaborate decoration of bark canoes in the same territory. It is not quite clear whether he intends to found any ethnological speculations on the fact that the custom of men swimming and towing rafts is found at Macquarie Harbour, on the western coast of Tasmania, and at Peterson Bay, in North Australia. It seems obvious, however, that this is a device which, like the materials and forms of the rafts in use at these places, 1800 miles apart, might be independently discovered by natives employing these primitive methods of navigation.

THE extensive literature dealing with American basketry unfortunately seems to be little known among art students and managers of industrial schools in this country, yet both these classes might with advantage consult it in their search for new schemes of decoration and for instruction in the technique of an art which has been brought to such a high degree of perfection by the Indian tribes. The last monograph on the art, as practised by the Pomo tribe in California, is that contributed to the seventh volume of the Publications of the University of California by Mr.

S. A. Barrett. The fibres used, except the bark of the red-bud, are drawn from the roots of plants and trees such as the sedge, carex, and pine. For the foundation material the slender stems of the willow are almost exclusively employed, while for the purposes of decoration the use of feathers and beads is one of its most characteristic features. In technique three different methods are in vogue, coiling, twisting, and wicker-work, of each of which there are numerous varieties. The complexity of the patterns, based on simple geometrical elements such as the line, triangle, rectangle, and rhomboid, is remarkable. To these elaborate patterns, each provided with a descriptive title founded upon some real or fancied likeness to some object bearing the same name, this tribe does not, as is the case with many of their neighbours, attach any religious or symbolic meaning. The numerous drawings accompanying this monograph entitle it to rank as an authoritative manual of this interesting form of artistic handicraft.

Dr. Hergesell, president of the International Commission for Scientific Aëronautics, has sent us a preliminary statement of the participation of the various countries in the work of investigating the upper air, from January to the beginning of July, 1908. Ascents were made in the early part of each of those months, with more or less regularity, from thirty-three stations, including two in the United States and one in Egypt, by means of kites, manned, captive, unmanned (registering), and pilot balloons. The latter do not carry instruments, but observations of wind direction at various altitudes are made by watching the balloons with theodolites. The registering balloons at many of the stations reached altitudes exceeding 18,000 metres; at Pyrton Hill (Oxfordshire) altitudes of 19,000 metres, and at Uccle several exceeding 20,000 metres, were attained. In compliance with a decision of the meeting of the commission held at Milan in 1906, an extended series of ascents took place, for the second time, at the end of July, 1908. The full results will be published later; a preliminary notice of some of them was given in our issue of December 31, 1908.

We have received the Journal of the Meteorological Society of Japan for the months August to November, 1908; abstracts of most of the papers are given in English. The following seem to us to be of especial interest:—(1) Observation of *Givre* in Hokkaido, by Mr. J. Yamada, in the August number. This is one of the terms left to the International Meteorological Committee to define in a precise manner. In the present paper it relates to the phenomenon sometimes called "rime," and which the author explains is formed after fog of some duration, and most frequently with temperatures below $-10°$ C. (2) The relation of barometric pressure to the pulsation of the earth, by Mr. N. Shimono, in the September number. The seismograph at Osaka showed that the oscillations became more frequent as barometric depressions approached, and decreased as they passed away. No relation was found between the wind and the pulsatory oscillation. We regret to note the death of the president of the society, Vice-Admiral Viscount T. Enomoto, which occurred in October last.

An interesting table showing the efficiency of various kinds of furnaces is given by Mr. J. W. Hall in a paper appearing in the Proceedings of the Birmingham Metallurgical Society for 1907–8. The difference shown between different types of furnaces is very marked. The highest efficiency in ordinary work is attained by an English blast-furnace making pig iron, in which 81·7 per cent. of the total heat given by the fuel is utilised and only 18·3 per cent. wasted. No less than 65·3 per cent. of the total heat, however, escapes from the furnace, but most of this is recovered outside in various ways. In a puddling furnace not fitted to a boiler, 91 per cent. of the heat is wasted, but the most wasteful furnace of all is the common coke crucible furnace employed in melting steel, in which 1·43 per cent. of the heat is used in the furnace and 98·57 per cent. wasted. Other papers printed in full in the Proceedings deal with the selection and testing of foundry irons, the sampling of pig iron, and the microstructure of a cartridge case.

An important paper on heat-flow and temperature-distribution in the gas engine was read by Prof. B. Hopkinson at the Institution of Civil Engineers on February 2. The author first investigates the probable heat-flow and temperature-distribution and gradients over the cylinder walls, dealing specially with those parts which are not water-jacketed, and then describes some experiments made on a 40 B.H.P. Crossley gas engine in his laboratory at the University of Cambridge. The temperatures at different parts of the piston, which was uncooled, and also of the exhaust and inlet valves, were measured by thermocouples. Under normal working conditions these temperatures were found to be in excess of the jacket-water temperature by 370° C. at the centre of the piston, 400° C. in the exhaust valve, and 250° C. in the inlet valve. It is very unlikely, as shown by Prof. Hopkinson's calculations, that the temperature of the inner side of water-cooled walls ever rises above quite a moderate value. There may be a temperature gradient in the piston face from centre to edge of 180° C., producing inequality of expansion which may give hoop stresses amounting to several tons per square inch. The author gives an interesting investigation of this problem. Experiments were made in order to ascertain the effects on the temperature-distribution of changing the strength of mixture, time of ignition, and degree of compression. An important set of experiments was also made on the phenomena of pre-ignition produced by overheating of part of the metal surface. A long iron bolt was introduced having a thermocouple at its end. The end of this bolt was heated from the explosions, when it was found that pre-ignition would not occur so long as the bolt temperature did not exceed 700° C. If the temperature exceeded 730° C. pre-ignitions occurred so frequently as to pull the engine up. It was found that the line of division between the conditions under which safe and continuous running was possible and those under which the engine was bound to pull up was very narrow, and can be represented by an increase in the gas charge of only 1 per cent.

We have received from the Société française de Physique a circular directing attention to the advantages offered by the society to its members, who already number more than fifteen hundred. The subscription for members in this country is only ten francs, and for this a member receives the fortnightly abstracts of communications made to the society, and the quarterly bulletin containing the complete papers. By paying three francs extra a member may have the *Journal de Physique* instead of the bulletin, and as the journal contains both the communications made to the society and abstracts of communications made to many other French, British, and German societies, this is a very inexpensive way of being kept up to date in matters physical. There are other advantages of membership which may be learnt from the secretary of the society, 44 rue de Rennes, Paris.

The only means of measuring very small gas pressures below one-thousandth of a millimetre of mercury has up

to the present been the McLeod gauge, the accuracy of which was called in question by the work of Sir William Ramsay more than a dozen years ago. In the January number of the *Verhandlungen der deutschen physikalischen Gesellschaft*, Drs. K. Scheel and W. Heuse, of the Reichsanstalt, describe a manometer they have constructed which allows them to measure small differences of pressure to an accuracy of about 0·00001 millimetre of mercury. The instrument consists of two metal reservoirs of small volume separated from each other by a membrane of copper 26 centimetres diameter and 0·03 millimetre thick, which bends under any difference of pressure in the two reservoirs by an amount proportional to the difference. The movement of its centre is measured by the aid of a Fizeau interferometer. By means of this instrument the authors have verified Boyle's law for air down to a pressure of 0·0001 millimetre of mercury, and have shown that the McLeod gauge will give trustworthy results at these low pressures.

THE Watkins Meter Co., of Hereford, has published a fourth edition of the useful "Watkins Manual of Exposure and Development," by Mr. Alfred Watkins. The little book, which contains an abundance of practical information, is sold at 1*s*. net.

THE fifth annual issue of M. Max de Nansouty's "Actualités scientifiques" has been published by MM. Schleicher Frères, of Paris. The volume contains a series of essays on scientific subjects of current interest, which range over the whole field of natural knowledge. It would be difficult to imagine a more interesting way for the student of science to keep up his knowledge of French, and at the same time revise and extend his acquaintance with recent work in his own particular subject of study. The price of the volume is 3.50 francs.

THE Dorset Natural History and Antiquarian Field Club offer the "Cecil" silver medal, and prize of the approximate value of 5*l*., for the best paper on "The Discovery of Radium: its Probable Origin, Present Development, and Possible Future Use." The competition is open to any person who was between the ages of eighteen and thirty on May 12, 1908, and was either born in Dorset or resided in the county for twelve months previous to that date. Papers should be sent by March 1 to Mr. Nelson M. Richardson, of Montevideo, near Weymouth.

OUR ASTRONOMICAL COLUMN.

INTERACTION OF SUN-SPOTS.—In a paper published in No. 1, vol. xxix., of the *Astrophysical Journal* (p. 40, January), Messrs. P. Fox and G. Abetti discuss a number of observations which lead to the conclusion that in many individual cases, if not in general, there exists a physical connection between different groups of sun-spots.

A preliminary examination of Carrington's and of Spoerer's results showed that the coincidences of longitude in spots of different latitudes were no more numerous than would be called for by the probability of chance coincidence.

An examination of the Rumford spectroheliograms, taking into account, not only the coincidences of spots with spots, but also of spots with disturbed, flocculic, areas, showed that the coincidences were rather more numerous than demanded by chance, but the result was still indefinite.

However, when individual cases were considered, it at once became evident, from an examination of spectroheliograms, that separate spots, in about the same longitude but in opposite hemispheres, were physically connected. One example, illustrated by reproductions, shows the development of a spot (Greenwich, No. 6185) as a northern companion of a southern spot (Greenwich, No. 6184) between May 6 and May 13, 1907.

A more striking interaction is shown by a series of Hα spectroheliograms taken on September 10, 1908, on which violent eruptions are shown in connection with two spots in opposite hemispheres, these eruptions culminating in the gap between the spots being bridged over. Visual observations made during the four hours in which the whole of the display took place showed violent eruptions of hydrogen in the neighbourhood of the spots. Measurements of position indicated that between September 8 and 12 the northern spot advanced $3^\circ \cdot 3$ in longitude and $1^\circ \cdot 7$ in latitude towards the southern spot, the latter remaining stationary.

DISTRIBUTION OF THE STARS.—A result having an important bearing on questions relating to the distribution of stars is announced by Prof. E. C. Pickering in Circular No. 147 of the Harvard College Observatory.

An analysis of the Revised Photometry is now being carried out at Harvard, and among other results already obtained the following is held to be of sufficient importance to call for immediate publication.

If the stars were infinite in number and distributed at random throughout space, the number, N, in any given class brighter than magnitude, M, should be given by the formula $N = aM + b$, where $a = 0{\cdot}60$, and b is another constant. A previous determination of a, considering 4000 bright stars, gave the value 0·52, and the deficiency was attributed to the absorption of light by some interstellar medium.

In the present investigation the stars brighter than magnitude 6·50 were divided into six magnitude-groups, and then into two divisions. The one division included the spectral classes A and F (Type i.), the second included the classes G, K, and M (Types ii. and iii.), and it was found that whilst for the first $a = 0{\cdot}60$, for the second its value was only 0·51. From this result it is obvious that in any study of stellar distribution it is essential that the stars must first be classified according to their spectra.

JUPITER'S SEVENTH AND EIGHTH SATELLITES.—In No. 4300 of the *Astronomische Nachrichten* (p. 63, February 2) Sir William Christie publishes an ephemeris for J viii. computed from the elements previously published by Messrs. Cowell and Crommelin. This ephemeris gives the distance Satellite viii.—Jupiter, in R.A. and declination, for every fourth day between January 2 and March 19, the values given for February 19, for example, being $-7^{m}.\ 34{\cdot}8^{s}.$ and $-4'\ 46''$. Two photographs taken at Greenwich on January 16 gave the correction $+10{\cdot}3^{s}.$, $+2'\ 40''$; a second photograph was secured on January 19.

No photograph of J vii. has yet been obtained, every available opportunity having been employed to photograph the more recently discovered satellite. It is understood that an ephemeris for J vii. will appear in the second edition of the American N.A., 1909.

THE ANOMALIES OF REFRACTION.—In determining time by their circumzenithal apparatus, MM. Fr. Nušl and J. J. Frič found a discordance which they attributed to perturbations of the atmosphere lasting over an appreciable period. Whilst the small evanescent anomalies of refraction affected their observations to some extent, it was found that there was a superimposed anomaly the period of which would amount to seconds.

By an ingenious application of photography to their method, they have now succeeded in demonstrating the existence of this second anomaly, and find its period to be of the order of twenty seconds, whilst the amplitude of the movement it causes is about $1''$ of arc.

The results, and the methods by which they were obtained, are discussed and illustrated in No. 13, 1908, of the *Bulletin international de l'Académie des Sciences de Bohême*.

THE STORY OF THE TELESCOPE.—In view of the tercentenary of the telescope, Mr. Mee has issued a very interesting little brochure, in which he reviews the more important events in the development of the instrument. He also adds useful lists of observatories, large telescopes, astronomical societies, &c., and tabulates the chief astronomical events since the death of Copernicus in 1543. This work can be obtained from the author, Llanishen, Cardiff, price 6*d*.

REGIONAL AND STRATIGRAPHICAL GEOLOGY.

AMONG the latest memoirs published by the Geological Survey of Great Britain in 1908 are three dealing with familiar ground. Mr. C. Fox-Strangways writes on "The Geology of the Country North and East of Harrogate" (price *2s. 6d.*), in explanation of Sheet 62. A geological map of the district round Harrogate is inserted as a plate in the memoir, and the photographic views, including the famous dropping well of Knaresborough, will interest visitors who may not be specialists. There is a chapter on the history and origin of the Harrogate springs, which are held to arise from independent sources in the hills west of the town, obtaining their chemical ingredients as they pass through the Lower Carboniferous strata towards the spots where they emerge. These strata are provisionally retained as Yoredale beds.

Messrs. A. J. Jukes-Browne and H. J. Osborne White, in explanation of Sheet 254, write of "The Country around Henley-on-Thames and Wallingford" (price *2s.*). The colour-printed map (price *1s. 6d.*) was issued in 1905, and a slight correction of it, as regards the zones of the chalk north of Henley, is given, on a somewhat reduced scale, in the memoir. The country depicted includes the well-known road that climbs from Henley to the woods of Nettlebed, and drops again over the face of the Chalk to the Thames alluvium at Benson. From Dorchester, one of the pleasantest of Oxford villages, we look back at the fine Chiltern scarp, through which the Thames cuts deeply. A map like this, with the section at its foot, explains a delightfully varied piece of country. The memoir hardly directs sufficient attention to the interest of the various gravels and to the problems of pebble-distribution in connection with the present valley, but the facts can, of course, all be found in Mr. White's chapters on the superficial deposits, where numerous references to other works are given. Mr. White shows how subaërial wasting (p. 79) has been going on here since Oligocene times, so that the pebble gravel of the Chiltern slope can have no definite age assigned to it. He regards the exotic pebbles, such as those of quartzite, that occur in the "plateau gravel" (p. 85), as derived from the older "pebble gravel," and as "carried into the region of the Upper Thames basin long before the commencement of the Pleistocene 'Ice Age.'"

That energetic writer, Mr. A. J. Jukes-Browne, has also prepared the memoir on "The Country around Andover" (price *1s. 6d.*), accompanying Sheet 283. The map (also price *1s. 6d.*) was issued in 1905. In this area we are on the great undulating plateau of chalk, over which men still travel fast—often far too fast—on the way from Basingstoke to Bath. The beautiful little valley of Kingsclere adds variety in the north-east, where a breached anticline exposes Selbornian Upper Greensand. This fold is illustrated by a section on the map itself. The uninitiated, however, must remember that the exaggeration of the vertical scale, harmless enough in the right-hand portion, produces an unfortunate effect where the dip changes rapidly on the left, the Chalk appearing as if compressed to one-third of its thickness at the outcrop. The memoir deals with the Cretaceous zones in a manner that was impossible when the area was first surveyed in 1857. In conclusion, it touches on springs and water-supply, questions of special importance in such a region.

A fourth memoir, on "The Country between Newark and Nottingham," by Messrs. Lamplugh, Gibson, Sherlock, and Wright (price *2s. 3d.*), describes Sheet 126, published in 1908. There is very little glacial drift in this part of the Trent valley, and the surface is mainly occupied by Triassic strata. The chief point of interest for the dwellers in this agricultural country lies in the fact that the Coal-measures, which crop out west of Nottingham, probably underlie the whole of it. Indications of concealed faults, known already from subterranean workings, are shown by orange lines upon the map. The longitudinal section below it is properly non-committal as to the concealed coalfield; but the Clifton Colliery has already burrowed under the Trent, and the whole land eastward may yet become a "black country," with the Trent as its convenient waterway. The soils of the district are interestingly referred to on pp. 96–7.

In the Proceedings of the Geologists' Association, vol. xx. (1908), p. 390, Messrs. C. P. Chatwin and T. H. Withers describe the zones of the Chalk in the Thames valley between Goring and Shiplake, a district bearing on those recently examined by the survey. The work of these authors is, in fact, referred to in the Andover memoir. The united evidence shows that the higher zones of the Senonian were denuded away over a wide area in our Midlands before the deposition of the Eocene strata.

A special character was imparted to the later work of Mr. J. Lomas by the broad geographical outlook of the author. This is apparent in his description of the geology of the Berwyn Hills (Proc. Geol. Assoc., vol. xx., 1908, p. 477), which serves as a useful companion for any visitor to Llangollen. We may mention the account (p. 488) of the walls of the Dee valley, and their relation to former glaciers, as an example of the features here clearly brought before the reader.

In the *Jahrbuch d. k.k. geol. Reichsanstalt* for 1908, pp. 469–526, Dr. H. Reininger furnishes an interesting study of the Tertiary basin of Budweis, near the southern Bohemian border. He concludes that the plant-bearing beds were laid down in a considerable lake in Middle Miocene times between steeply falling walls of crystalline rock. The Alpine movements (p. 511) gave rise to the hollow in which the water gathered, despite the general resistance of the old Bohemian mass that surrounds the basin. Dr. Reininger points out that numerous fissures were produced in Bohemia by pressures of even later date, and that the basin of Budweis was probably uplifted with the southern Böhmerwald at some time later than the Miocene. Here we approach the edge of controversy, and once more look towards the Alps.

It is impossible to do justice, however, either in the study or the field, to the successive memoirs that appear on the tectonics of the Alps. In three numbers of *Petermann's Mitteilungen* (Bd. liv., 1908, Nos. 10, 11, and 12) Prof. Fritz Frech, of Breslau, has furnished a summary occupying forty-two pages, in which he endeavours to harmonise the views of various writers. Profs. Diener, Kilian, and Schardt have supplied descriptions of special districts, and Prof. Frech shows his fairness by a kindly reference (p. 223) to the gravitational theory of folding urged by Reyer. Emphasis is laid on the great faults that accompanied the folding in the eastern Alps (p. 256), such as the "Gailbruch," which manifested itself as late as 1346 in a terrific earthquake and a landslide, the huge scars of which can still be seen on the precipice of the Dobratsch as one leaves Villach for the south. Close at hand we find the region of the south Alpine Trias, a plateau-country cut up by vertical faulting. In his concluding sentences, Prof. Frech shows how the overfolded structure of the western Alps is connected with the dissimilar and broken structure of the east by districts, like the Brenner or the Radstädter Tauern, where both types lie near one another. This gives the Alpine chain an advantage over many other mountain regions; but the author points out (p. 282) that we may be led on from it to connect the folded ridges of Mexico with the faulted plateaus of Arizona and Utah, as manifestations of one and the same mountain-building process. The memoir is illustrated by photographic plates and sections.

Dr. Ampferer's paper on the Sonnwendgebirge, referred to by Prof. Frech in a footnote, appears in the *Jahrbuch der k.k. geologischen Reichsanstalt*, Band lviii. (1908), p. 281. Wähner has recognised certain "hornstone-breccias" intercalated among Jurassic radiolarian marls as evidences of overthrusts. Ampferer regards them as truly and evenly interbedded, and as resulting from the uplift of an eastern part of the sea-floor; the sediments already formed slipped down over the underlying slope of the Kossen beds, wrinkling themselves during this gravitational sliding. Denudation of the uplifted part by subaërial agencies set in, and the hornstone-breccias are evidences of this decay. The large blocks found in them may record actual landslips. Where the breccias are repeated, elevation and depression must have alternated. The Gosau beds were laid down unconformably on the surface due to this epoch of denudation. Features of this

kind are, of course, noticeable both in the Carboniferous Limestone and in the Chalk of our own islands. The main interest of Ampferer's paper from a tectonic point of view lies in its acceptance of Reyer's doctrine of what may be called "contemporary gliding."

In the *Verhandlungen* of the same institute (1908, p. 326) Prof. Tornquist, of Königsberg, replies to Dr. Ampferer concerning the Flysch-zone in Allgäu and the Vorarlberg, and he very interestingly pictures the formation of a submarine overthrust during the growth of the Flysch deposits. The Alps had even then begun to rise, and the limestone "klippe" of Allgäu was thrust over the earliest beds of Flysch and became entombed in those that were still forming. Tornquist opposes Ampferer's comparison of the phenomena with those brought about by landslides, and asks us (p. 331) to consider the effects of earth-movements on unconsolidated sediments still beneath the sea. He would like to explain, on the same principles, the "klippen" studied by Uhlig in the Carpathians. Even in the submarine processes described there seems to be a good deal that is akin to landsliding, but Tornquist makes the folding and the accompanying gliding contemporaneous with the Flysch itself.

Fig. 1.—Unconformity of Sub-recent Conglomerates on Cretaceous Limestone, Kalhat, Coast of Oman, Arabia. (Photo. by A. v. Krafft.)

From these closely criticised regions it is refreshing to come out with Dr. W. F. Hume into the unknown south-western desert of Egypt (*Cairo Scientific Journal*, vol. ii., 1908, pp. 279 and 314). His paper is meant for the general reader, and its style and contents would make an admirable lecture. A great southward extension of Eocene strata has been discovered by the author. His remarks on wind-erosion (p. 318) show, as one might not at first sight expect, that sand is absent where the signs of erosion are intense. The cutting agent finds no resting place, but is hurried over the edge of the desert plateau to fall in great sand-slopes towards the plain and to fill up valleys that are there sheltered from the wind.

In the Memoirs of the Geological Survey of India, vol. xxxiv., part iv. (1908), we have another of those broad surveys that are still possible in Africa and Asia, and that recall the days of von Buch, Murchison, or Darwin. Mr. G. E. Pilgrim has had the fortune to report on the geology of the Persian Gulf and the adjoining portions of Persia and Arabia. He too has felt that in science it is good to be a king,

And ride in triumph through Persepolis.

Mr. Pilgrim provides photographic views of barren landscapes, and a geological map, in which are correlated his own observations and those of his predecessors. Marine beds occur up to the Messinian and Pontian stage, *i.e.* into what are generally regarded as Pliocene times (p. 25), and the Persian Gulf is attributed to denudation acting still later on a mass that became upraised in some places 9000 feet above the sea. Then came a Pleistocene submergence, followed by still more recent elevation, of which we have evidence in the modern shorelines.

Mr. H. G. Ferguson describes the small Batanes Islands, the northern outliers of the Philippine group towards Formosa (*Philippine Journal of Science*, vol. iii., 1908, p. 1). The basal rock is a pre-Miocene volcanic agglomerate, and the islands are thus really volcanic piles. Miocene limestones were formed across them, and became uplifted to 275 metres above the present sea. The frequent earthquakes are correlated (pp. 14 and 24) with a fault that is possibly traceable into Luzon. Volcanic activity continued in the group during the time of uplift, and Mount Iraya, in the north of Batan, has quite a modern aspect.

That excellent observer, Mr. A. J. C. Molyneux, of Bulawayo, describes part of the Bechuanaland Protectorate in the Proceedings of the Rhodesia Scientific Association, vol. vi. (1906), p. 73. This district links itself interestingly with that reported on by the Survey of Cape Colony near Kimberley, and the author traces its Waterberg and Karroo strata also north into Rhodesia (p. 86). But should he write both "Karroo" and "Karoo" on successive pages? The basalts of the Victoria Falls area are correlated with the Tuli lavas of Bechuanaland and with the volcanic rocks of Stormberg age farther south.

Fig. 2.—Extinct Volcano of Mount Iraya, in Batan Island, Philippines. (Photo. by Worcester.)

Passing to America, Mr. E. Otis Hovey has described for the first time the general geology of the western Sierra Madre in the State of Chihuahua, Mexico (Bull. Amer. Museum Nat. Hist., vol. xxiii., 1907, p. 401). The region is likely to be developed from a mining point of view, but is mainly given over to stock-raising. It

owes its relief to denudation, acting on a plateau of Cretaceous limestone and andesite, on which lava-flows of basalt and rhyolite, with additional andesite, have broken out. Important post-Cretaceous intrusions of granite occur. The broad, enclosed basins of the plateau, which are well illustrated, became filled up by débris, largely wind-borne, and sandstones and conglomerates arose which almost obliterated the original relief. The present tendency is still towards the filling of such basins by the crumbling of outstanding relics of the older surface under the action of an arid type of denudation; but rivers have cut modern cañons through the mass, and are producing a new series of relief-features. It is interesting to note (p. 422) that hanging valleys have been left in the cañon of the Aros "by the more rapid cutting done by the great stream."

Mr. A. Gibb Maitland chose as the subject of his presidential address to the Australasian Association for the Advancement of Science in 1907 "The Geology of Western Australia." This address forms a convenient summary of recent work, now that it has been published by Mr. Bristow, Government printer in Adelaide. Attention is directed (p. 10) to the attractions offered by the Cambrian beds of the Kimberley district, from which Hardman gathered an unlocalised Olenellus in 1883. The glacial boulder-bed east of the Kennedy Range (p. 16) is of early Carboniferous age. Laterite, in part pisolitic, occurs throughout Western Australia (p. 24), and is recognised as resulting from the decomposition and re-consolidation of the underlying rocks *in situ*. These rocks are commonly granites. Secondary silica converts some types of the laterite into quartzites; others pass over into bauxite. Here once more we are in face of the most interesting problem of weathering presented to us in the tropics. The laterite has been cut through by denuding agents, and some of it may be of early Cainozoic age, while in other places it is still forming.

Among papers dealing with special systems rather than with regional geology we may note one by Messrs. W. G. Miller and C. W. Knight on the Grenville Hastings unconformity (Sixteenth Report, Bureau of Mines, Canada, 1907, p. 221), in which it is urged that the Hastings series in Ontario and Quebec has an independent position, being unconformable to the underlying Grenville series, and not merely an altered portion of that series. The Laurentian gneiss is intrusive in the Keewatin series and in the overlying Grenville series in south-eastern Ontario. The Hastings series is styled Huronian by the authors.

Sir T. H. Holland (Records Geol. Surv. India, vol. xxxvii., 1908, p. 129) shows that the Blaini formation of Simla, in which he now finds well-striated boulders, need no longer be correlated with the Talchir beds, but may be much older, since glacial conglomerates are known from various horizons. The unfossiliferous sediments below it, hitherto regarded as Permian or older, may be actually as old as the pre-Cambrian, and may be classed with the author's Purana beds of the peninsular area.

In the same Records, vol. xxxvi. (1907), p. 23, Mr. H. H. Hayden discusses the age of the Gangamopteris beds of Kashmir, and furnishes good photographs of their occurrence in the field. These beds are "not younger than upper Carboniferous," since equivalents of the Fenestella-shales of Spiti overlie them.

A very interesting paper on desert conditions and the origin of the British Trias was contributed by the late Mr. J. Lomas to vol. x. of the Proceedings of the Liverpool Geological Society (1907), p. 172. Personal observations in Africa were utilised, and the author lost his life, as already recorded in NATURE (vol. lxxix., p. 226), while extending his researches in an area from which he hoped to gather much. Prof. Bonney, who has so long studied the Triassic pebble-beds, has commented on Mr. Lomas's conclusions in the *Geological Magazine* for 1908. Our knowledge of the marine Trias of Europe is increased by Dr. F. v. Kerner, who publishes a considerable paper on the southern border of the Svilaja planina in Dalmatia (*Verhandl. d. k.k. geol. Reichsanstalt*, 1908, pp. 259–289). In the uppermost zone there are reefs formed by calcareous algæ, with intervals of ordinary sediments between them, where detritus from earlier volcanic rocks was washed in among the limestone-building organisms.

Coming to much more recent times, Herr B. Stürtz, of Bonn, has made a detailed study of the "Rheindiluvium" from Bingerbruck, near Mainz, downwards to the Netherlands (*Verhandl. d. naturhist. Vereins der preuss. Rheinlande u. Westfalens* for 1907, published 1908, pp. 1–91). He does not seem to take into consideration the older extension of the alluvium of the Rhine to the English coast, which many authors have looked on as a feature of late Pliocene times. He regards the old delta as beginning near the Ahr, midway between Coblenz and Bonn, at a time when the stream-bed was some 150 metres higher than at present. A broad plain dropping seaward to the area of the Netherlands allowed the river to wander in various arms, much as it does now in Holland, and these arms have left their traces in high-level "diluvial" gravels. The present valleys of the main stream and of its tributaries must have been deepened by 100 to 200 metres in Pleistocene and recent times. The effects of the damming up of the waters by the Scandinavian ice-front are discussed. The higher deposits of löss are, however, attributed to wind-action, while others were laid down in a glacial lake between the uplands and the ice.

G. A. J. C.

A REMARKABLE DEVELOPMENT IN X-RAY APPARATUS.

THE old induction-coil seems likely to have a serious rival in the new apparatus which Messrs. Newton and Co., of Fleet Street, are showing. This is the "Snook" Röntgen apparatus. The machine consists of a motor converter driven from the continuous current mains, and supplying an alternating current to a step-up transformer. This transformer is immersed bodily in a galvanised iron tank filled with an insulating oil, the whole being hermetically sealed. The voltage at the secondary terminals of this transformer amounts to as much as 70,000–100,000, and can be regulated as required by means of an adjustable resistance in the primary circuit.

The most important adjunct is a mechanical rectifier, consisting of a rotating commutator of special design carried on the axle of the motor converter; thus it cannot get out of step, and, what is perhaps of as great importance, it requires no attention. The commutator when once adjusted in proper phase produces a very nearly unidirectional current, although, of course, perfection in this respect is unattainable, as will be realised when it is remembered that the current from the converter cannot be a simple harmonic one. Be this as it may, the rectification is very successfully made, and the simplicity of the device commends it when compared with the very troublesome valve tubes which must so frequently be employed for heavy X-ray work.

With regard to the efficiency, a current of 25 amperes at 200 volts in the primary circuit yields 60 milliamperes or more through an X-ray tube of 3 or 4 inches spark. Having inspected the apparatus while in action, we may state that we consider it to be a most efficient addition to the numerous arrangements available to the present-day worker in X-rays.

RECENT PAPERS ON MARINE ANIMALS.

AMONG papers on various groups of marine animals in serial and other publications which have recently reached us, reference may first be made to a fasciculus of "Illustrations of the Zoology of the Indian Survey Ship *Investigator*," containing plates devoted to new and other species of fishes, entomostracous crustaceans, and molluscs. In addition to certain deep-sea forms, the fishes include two species of skate, described by Dr. R. E. Lloyd in 1906, several kinds of stalked barnacles are figured, and the molluscs include seven species, described by Mr. E. A. Smith in the year already mentioned, of which the shells are for the first time depicted.

Reverting to fishes, we find Messrs. Gilchrist and Wardlaw Thompson contributing to the second part of vol. vi. of the Annals of the South African Museum one paper on the local Blenniidæ and another on various species from the Natal coast. The blennies have hitherto been very

imperfectly known, in spite of their comparative abundance, and some of the species are extremely difficult to identify. Out of a total of thirty-eight South African representatives of the family, no less than twenty-two belong to the genus Clinus, of which twelve are described by the authors as new. In the second paper a very large number of species belonging to sundry genera and families are named and described; one of these—referable to Chrysophrys—is locally known as the "Englishman," and the authors have accordingly named it *Ch. anglicus*, which scarcely seems a satisfactory designation for a South African species.

To the issue of the Proceedings of the Academy of Natural Sciences of Philadelphia for December, 1908, Mr. H. W. Fowler contributes a paper on the Pennsylvanian fresh-water fishes of the family Cyprinidæ, in the course of which a new species of Notropis is described. Owing to pollution of the streams, some species of these fishes are in danger of extermination.

Much has of late years been written on the development and life-history of the eel, a further addition to the subject being a paper, illustrated with figures and a map, by Mr. Knut Dahl, which appears in the January number of *Naturen*.

From fishes we pass to whales, the Arctic fishery for which during the past season receives a brief notice by Mr. T. Southwell in the *Zoologist* for January. Six vessels were dispatched for whaling purposes in 1908, two of which visited the Greenland seas, while three proceeded to Davis Strait and one to Hudson Bay. The Greenland fishery proved the most productive, yielding ten out of the fifteen right-whales constituting the season's catch. In addition to these, the season's expedition yielded 540 white whales, 899 walruses, 3084 seals, and 241 bears. With whalebone at about 2000*l.* per ton, the total value of the produce (inclusive of a cargo brought from Pond's Bay station by the *Eclipse*) may be estimated at between 29,000*l.* and 30,000*l.*

Turning to invertebrates, the first paper for notice is one by Dr. J. Stafford, of Montreal, published in the January issue of the *American Naturalist*, on the larva and spat of the Canadian oyster. The fact that American oysters are unisexual renders possible artificial fertilisation of the eggs and rearing of the larvæ, and these young stages have been long familiar to the naturalist, but there was a big gap in our knowledge between these stages and the fixed condition. Accordingly, the author set himself the difficult task of learning to identify oyster-fry amid the hundred forms of life to be met with in the pelagic plankton. In this he was eventually successful, having observed what he took to be the larvæ settle themselves on glass plates and develop into undoubted oyster-spat. Further study of the plankton will probably enable the height of the breeding-season to be definitely determined. At present it seems that oyster-larvæ occur in the water from July 11 to September 1, and that spat make their appearance from August 16, thus suggesting that during the second half of August there occur the last stages of growth of late larvæ, and that the period of growth of the masses dates from between July 11 and August 16. The eggs are therefore probably deposited about the first of July. The paper concludes with a summary of the results of the author's investigations, and also contains remarks upon the important bearing of these and earlier observations on the problems and methods of artificial oyster-culture.

The last two papers for notice are by Dr. Gilchrist, the one, in the above-mentioned issue of the Annals of the South African Museum, on two new species of Ptychodera, and the other, in vol. xvii., part ii., of the Transactions of the South African Philosophical Society, on new forms of Hemichordata from South Africa. In the former paper Dr. Gilchrist observes that, in addition to the undermentioned *Ptychodera capensis*, another representative of the same genus is found in the same localities in fair abundance under stones, but usually somewhat nearer to high-water mark. Among the adult forms were found a number of smaller ones, in which the proboscis and collar were in all stages of development, this apparently indicating a process of natural fragmentation or proliferation from the tail end of this species, for which the name *Pt. proliferans* was accordingly suggested. The second, *Pt. natalensis*, is from the Natal coast, and is characterised, among other features, by the extremely short proboscis. *Pt. capensis* is described in the second paper.

In the latter paper it is mentioned that the three orders of the Enteropneusta are now known to be represented in South African waters, the Enteropneusta by the above-mentioned species of Ptychodera, the Pterobranchia by a species of Cephalodiscus, and the Phoronidea by a new species of the type-genus (*Phoronis capensis*), and by the new genus and species *Phoronopsis albomaculata*. The last-named, which is figured in its fully expanded form alongside *Phoronis capensis*, is an exceedingly beautiful organism, differing from the type-genus mainly in having an involution of the epidermis with definitely differentiated (cubical) cells. The involution occurs below the nerve-ring, which it partially covers, and passes round the body so as to encircle the mouth, vent, and nephrideal apertures.

MEANING AND METHOD OF SCIENTIFIC RESEARCH.[1]

IN this day of encyclopædias numerous and ponderous, one is often struck with the fact that in spite of the manifest care and conscientious thought bestowed by the responsible editors, the omissions and evidences of discontinuity of treatment, and lack of recognition of the prime purposes of the compilation, are as noteworthy as the imposing array of the results of our steadily advancing knowledge is startling. For a philosophic treatment—one fully appreciative of that which the student really requires, not only to enlighten him with regard to a particular subject, but also to stimulate him to research where it is most needed—I frequently get more satisfaction out of the older encyclopædias than from our modern ones, even though they can but present the status of the subject up to the time they were written.

As an illustration, take the word "research," or any of the associated terms—"discovery," "experiment," "investigation," and "observation." Turning to the index volumes of the ninth and tenth editions of the "Encyclopædia Britannica," I find but two references in which the word "research" appears—one to the exploring vessel, the *Research*, and the other to "research degrees." Turning to the page on which the latter occurs, we find this interesting statement referring to Oxford University:—

"New degrees for the encouragement of research, the B.Lit. and B.Sc. (founded in 1895, and completed in 1900 by the institution of research doctorates), have attracted graduates from the universities of other countries. In 1899 a geographical department was opened, which is jointly supported by the University and by the Royal Geographical Society." Now comes the interesting statement which I beg to emphasise:—"*Of more bearing on practical life are the Day Training College Delegacy* (1892) *and the diploma in education* (1896). *Under the former elementary school teachers are enabled to take their training course at Oxford, and do so in growing numbers,*" &c.

We thus see what the writer of this article thinks of the relative value in practical life of research foundations and normal school foundations! Sir Norman Lockyer, in his luminous inaugural address before the British Association for the Advancement of Science in 1903, on the "Influence of Brain-power on History," says:—"A country's research is as important in the long run as its battleships." Why, then, does not the standard encyclopædia of that country make space for a representative article on "research"?

Under "investigation" there also appears absolutely nothing. However, we have the *Investigator* ship, Investigator Shoal, Investigator Group, &c., but not a word about the general methods employed by "scientific investigators"; and so it is with the word "discovery"—there is no reference whatsoever to an article on the

[1] Abridged from an address by Dr. L. A. Bauer as retiring president the Philosophical Society of Washington, delivered before the Society on December 5, 1908.

general principles leading up to discoveries. Likewise with the word "observation." Though there are many references to observations of various kinds, there is no one article for setting forth the general principles of "observations" or the part they play in the discovery of fundamental facts. The same experience is had with regard to the word "experiment."

Now let us turn to an encyclopædia I invariably read with pleasure and profit; it frequently has supplied me with references to earlier work not to be obtained elsewhere. We shall find it instructive, though the articles to which I beg to invite your kind attention were written three-fourths of a century ago. I refer to the classic Gehler's "Physikalisches Wörterbuch"—the revised edition by the noted investigators Brandes, Gmelin, Horner, Littrow, Muncke, and Pfaff, in twenty volumes, and published in Leipzig, 1825–45. A veritable fund of information is found under the headings "Beobachtung" (observation) and "Versuch" (experiment). The article on "Beobachtung," by the physicist Muncke, embraces twenty-eight octavo pages. He shows the distinction between "Beobachtungen" (observations) and "Versuche" (experiments) to be that the former pertain to the perceptions of phenomena presented to us by nature in her unmodified course, whereas in the latter—in the experiments—we are seeking to produce certain results or phenomena, more or less looked for, in order either to verify a law already known or to disprove one suspected of being wrong, or even to discover a new one. Both classes of experiences are necessary for a piece of investigation or research work.

Thus we may behold, either visually or in some other way, certain striking solar phenomena; these belong to the class of observations which we ourselves are unable to modify in any manner whatsoever. Continued observation may, however, reveal a certain law which by experiment in the laboratory, conducted along more or less definite lines, we may seek to imitate in the hope of getting some clue to the *modus operandi* of the observed phenomena. In this article on "observations" the author treats in detail the various elements entering into correct methods of investigation, condition of the observer and of his senses, his being unbiased, character and errors of the instruments, errors of results, methods of increasing accuracy, representations of observations by graphs and formulæ, method of least squares, &c. He points out the mistake sometimes made that an established formula satisfying the observed phenomenon within certain limits represents an actual law of nature.

The article "Versuch" (experiment) consists of forty-four pages, and is contributed by the astronomer Littrow. He shows that the most rapid development takes place in those sciences which afford the greatest opportunity for experimentation, referring, *e.g.*, to the slow and painful progress of the astronomer so long as he had to confine himself to mere celestial observations, and the comparatively rapid strides which occurred so soon as some of the observed phenomena could be either imitated by, or be compared with, those derived by laboratory experiment. The investigator, he says, must be absolutely free from preconceptions, and be careful, cautious, and unbiased in his interpretation of what his senses may reveal to him. He illustrates how man, called jokingly "das Ursachenthier" (the animal ever bent on ascertaining the cause of things), proceeds in ferreting out the why and wherefore of observed phenomena, and how his methods of circumspection develop with the advance of knowledge.

Though man cannot determine the "Endursachen," or ultimate causes of things, the field open to him to discover the laws governing phenomena or *vice versâ*, classifying and enumerating those which follow a certain revealed law, is, nevertheless, still very large and sufficient to tax his energies. Witness, for example, the host of observed phenomena obeying the law of inverse squares!

These two articles will show sufficiently the character and scope of similar ones we should like to see in our standard English and American encyclopædias.[1] Such information is contained in some measure, at least, though not as comprehensively, in the modern German book of reference, Brockhaus's "Conversations-Lexikon," as also in the "Grande Encyclopédie" of the French.

[1] Chambers's Encyclopædia is found to contain a short article on "Experiment": also one on "Observation."

Our foremost English dictionaries are in general not any more satisfying or edifying regarding the precise meaning of "research" in the scientific sense than are the standard encyclopædias. Their illustrations of the use of the word are usually neither apt nor sufficiently comprehensive.

A good-sized chapter might be written on the "mathematical instruments or tools of research." The predominating tendency of resolving or expressing every natural phenomenon—periodic or otherwise—by a Bessel or a Fourier series or by spherical harmonic functions has brought about at times, especially in geophysical and cosmical phenomena, if not direct misapplications, at least misinterpretations of the meaning and value of the coefficients derived.

Frequently by the purely mathematical process there have been eliminated, in the attempt to represent a more or less irregularly occurring natural phenomenon by a smoothly flowing function, the very things of chief and permanent interest. The normal or average diurnal temperature curve, for example, or a uniform magnetic distribution over land, so as to yield perfectly regular lines of equal magnetic declination, never occur in nature. There is thus being impressed upon us more and more forcibly the fact that what we have been regarding as "abnormal features"—the outstanding residuals between observations and the results derived from the mathematical formula—are in truth not "abnormal" from the standpoint of nature, but are rather to be taken as indicative of the "abnormality" or "narrow-mindedness," which means the same thing, of ourselves in trying to dictate to nature the artificial and regular channels she should pursue in her operations.

Louis Agassiz said:—

"The temptation to impose one's own ideas upon Nature, to explain her mysteries by brilliant theories rather than by patient study of the facts as we find them, still leads us away."

The fundamental law of nature is to follow invariably the paths of least resistance, and by examining these lines of structural weakness of the opposing systems we may have opened to us the very facts which are to be of real value and of sure benefit to mankind. The irregularity of the banks bordering a natural watercourse serves to differentiate the work of nature from that of the builder of the artificial and regular channel.

No, instead of rejecting, we must learn to retain the outstanding residuals and study them most carefully and regard *them* as the true facts of nature, and not those which we so egotistically and presumptuously try to force on her. What great discoveries may lie open to us when we once have grasped the true significance of the facts we have been so fond of measuring by our own standard and have been terming as "abnormal" or "irregular"!

An interesting example of not wholly successful application of the continuous and ever-recurring functions of spherical harmonics to a typical geophysical phenomenon—the distribution of magnetism over the earth's surface—has been discussed by me elsewhere. Though the number of unknowns has been increased in recent computations from the original twenty-four of Gauss to forty-eight, nevertheless the difference between theory and observation is of such an order of magnitude as to preclude the use of the formula for even the purely practical demands of the navigator and surveyor. Nor has anyone succeeded in giving any physical interpretation of the laboriously derived coefficients beyond the first three. And what do these three stand for? The simplest possible case of a first approximation to the actual state of the earth's magnetism, viz. that of a uniform magnetisation about a diameter inclined to the axis of rotation!

The prime difficulty here may be summed up in a word. The very surface over which the spherical harmonic functions are spread is itself such a prolific source of disturbance as to cause effects embracing a continent, a State, or a locality. Such a large number of terms would be requisite for an adequate representation as to make their

computation prohibitive. We are dealing here with more or less discontinuous effects that cannot be imitated by continuous functions without leaving behind a train of residuals, precisely as though we were to try to fit to the actual configuration of the earth some standard pattern of our own. Let me ask what phenomenon have we, in fact, which will admit of the determination of forty-eight, or even of twenty-four, physical constants?

It had been my intention to say a few words on the value and limitation of that much-used as well as abused mathematical instrument of research, the method of least squares. Properly employed, it is a most useful adjunct to investigation; but, as intimated, the true significance of formulæ established by this method is at times pushed way beyond the limitations. What the tenor of my remarks might be will be sufficiently evident to you if I submit this query for your consideration, What actual laws of nature have been discovered by the method of least squares?

It is an extremely interesting and suggestive fact that the greatest experimental discoveries to-day are not made in the older, well-recognised sciences, but on their borderlands—in the "twilight zone" of more or less related sciences. I have but to mention the words "physical chemistry," "physical geology," "astrophysics," "biochemistry," &c., and you will readily grant the assertion made. In the overlapping regions there seem to be the greatest opportunities afforded for solid, thorough, and at the same time remarkably rapid, experimental achievements; and so we are having produced almost daily new specialities or new subspecialities.

What is the effect on the general broad-mindedness of man of this extreme specialisation, so necessary for the production of the best and most far-reaching results? *Is the modern specialist more narrow-minded than the generalist of a century or two ago?* In view of the fact that the prime instrument of research is, after all, the mind, the question is not an irrelevant one. We find statements occasionally made which would imply an affirmative answer to our question; but I, for one, would most emphatically protest against such an inference. I should maintain that the specialist, other things being equal, is likely to be a broader man than he who has no speciality, but simply a general knowledge of some particular science. The reason for my positive statement would be found in the fact mentioned, that the greatest part of the research work to-day is being done on the border-lands of the general sciences, for he who wishes to take part in this very active competition must needs be far better equipped than the mere generalist. The physical chemist, to be most successful, must have a very intimate knowledge of both physics and chemistry, and the more mathematical skill he possesses the better. The astrophysicist must be a physicist, a chemist, a mathematician, besides being an astronomer. And so with regard to the geophysicist.

Only a few names need be cited—like those, for example, of Faraday, Maxwell, Kelvin, von Helmholtz, Mascart—to support the contention that the broadest physicists are, as a rule, those who have regarded their laboratory experiments and deductions therefrom merely as a means to an end, not an end in themselves, and who have accordingly sought to apply the knowledge gained to the solution of some of the great problems affecting the general welfare of man. There is the greatest need in America of well-trained and well-equipped physicists in the solution of the many perplexing problems of the earth's physics with regard to the phenomena of seismology, vulcanology, meteorology, atmospheric electricity, terrestrial magnetism, &c. When the investigator makes the attempt to apply some of his laboratory facts to geophysical and cosmical phenomena, he has opened to himself a world of which he never dreamed; he finds zest in familiarising himself with the fundamental facts of other sciences in which until now he could take no interest.

It is always interesting to know what was the precise course followed in the discovery of a great law. However, no two investigators have ever pursued, or at least but rarely, precisely the same paths, and we must therefore be content with the statement of the general principles of research such as has already been given.

A prevalent fault is observed in scientific publications whenever the investigator has had good training only on the observational side, and but very little experience in scientific computing. He is very apt to violate one of the first and fundamental principles of good observing, viz. to employ such a method or scheme of observing as will yield but one definite result, and that with the highest possible accuracy and with the least amount of computation. Oftener than may be thought, schemes of observation are used which leave an arbitrary element to the computer, and in consequence a different result is forthcoming, according to who makes the computation. Had we time, apt illustrations could readily be given from published works. The point made, that the observer must also bear in mind the computation side, and work up his results as soon as possible, is of fundamental importance in research work.

It may be worth while to consider briefly the insatiable desire of the analyst to ring in a series of sines and cosines to resemble the course of some natural phenomenon of which he does not know the exact law. Is this the old story over again, though in somewhat altered garb, of the epicycles and deferents of ancient astronomical mechanics, which received its highest development in the Ptolemaic system of the universe? You will recall that Ptolemy, building on the suggestions of Apollonius and of Hipparchus, supposed a planet to describe an epicycle by a uniform revolution in a circle the centre of which was carried uniformly in an eccentric round the earth. By suitable assumptions as to his variable factors he was thus able to represent with considerable accuracy the apparent motions of the planets and to reproduce quite satisfactorily other astronomical facts. This was the artifice employed by the astronomer of the period before the modern and more subtle art of simulating nature, by the sine-cosine method, had become known.

What seemed so intricate and complex in Ptolemy's time could be expressed in very simple language indeed, when a Kepler discovered the true functions as embodied in his three fundamental laws. The present method of hiding our ignorance of the real law seems at times to exert such a mesmerising influence as to make us mistake the fictitious for the real.

Of course I do not mean to discard this useful and, in fact, indispensable tool of research, but simply wish to direct attention to its limitations and to the importance of not overlooking the fertile by-products, the residuals, which, because of our neglect of them, may some day rise and smite us in their wrath. Each one of us at one time or another has doubtless established, by least squares, an empirical formula of some kind which so beautifully fits the observations as to make us bold and venturesome. Now comes a new observation, somewhat outside of the range for which the expression was established. Eagerly the test is applied, and we find to our chagrin that the formula on which so much work had been spent will not fit the new result, and that we have a "counterfeit" and not the real law.

Let us suppose, for illustration, we are dealing with a phenomenon which almost entirely unfolds itself during the time between sunrise and sunset—the well-known diurnal variation of the earth's magnetism is a striking case of the kind. Following the usual method, the phenomenon is resolved into component parts with the aid of a Fourier series. The formula as generally adopted includes the four terms having, respectively, periodicities of 24, 12, 8, and 6 hours. For ordinary magnetic latitudes the striking result is obtained that the second term—the 12-hour one—is as important as the first, or 24-hour, one; so we might equally as well say "the semi-diurnal" as "the diurnal variation of the earth's magnetism." In fact, as the semi-diurnal term unfolds itself twice in twenty-four hours, it is in reality more important than the purely diurnal one.

Does the resolution into Fourier terms of a phenomenon of the kind given really prove their existence in nature? Can we conclude, without question, *e.g.*, that in addition to the diurnal term we also have a semi-diurnal one? Even with four terms the series does not represent each hourly observation of the twenty-four with the same degree of precision. In fact, the residuals for the night hours are nearly of the same order of magnitude as the observed quantities. If the physical existence of the 12-hour term

is not proved, then there is no need of racking our brains as to its physical origin.

The difficulty disclosed by this example is of the same kind as the one treated in spherical harmonics, viz. that we are attempting to represent a discontinuous function having a duration commensurate with that of the daylight hours by functions running smoothly through their individual courses for twenty-four hours.

I cannot close this section better than by quoting the following passage from the address of the first president of this society, Joseph Henry, given on November 24, 1877:—

"The general mental qualification necessary for scientific advancement is that which is usually denominated 'common sense,' though, added to this, imagination, induction, and trained logic, either of common language or of mathematics, are important adjuncts. Nor are the objects of scientific culture difficult of attainment. It has been truly said that the 'seeds of great discoveries are constantly floating around us, but they only take root in minds well prepared to receive them.'"

Henry's insistence on the application in our scientific work of "common sense" reminds one of Clifford's apt definition of science as being "organised common sense."

It may be taken as almost axiomatic that whatever is worthy of investigation should be made known in some effective manner, so as to reach without question those concerned. The multiplicity of literature on any one subject, or even on any small portion thereof, is nowadays such that the worker finds it utterly impossible to keep abreast of publications, even those in his own field, to say nothing of kindred ones.

He is forced more and more to rely on abstracts—at least in so far as to direct him to that which he unquestionably must consult in the original, if possible. As the investigator usually finds it necessary to consult the original publications, the next conclusion to be drawn is that the publication of any research work should, in general, be of such form and size as to permit the widest distribution possible, not only among the libraries and the principal seats of learning, but also among the workers and institutions immediately interested.

The scientific worker generally does not possess the means to purchase or to construct the instruments he requires for the prosecution of his work, and a book bearing in any way on the line of work to be pursued is as much to be considered part of his equipment as the purely mechanical tools. Indeed, I was told by the late von Bezold that Wilhelm Weber set his laboratory students to work by telling them, "Here are the instruments, and there are the *Annalen der Physik*; now go to work." The man of science usually wants his tools close by and within ready reach. He cannot afford to go to a distant library and then possibly find the book out. Private possession permits him, furthermore, to make marginal notes and references to enable him quickly to put his finger on the very thing needed.

Owing to these well-recognised needs, there has grown up a courteous and friendly interchange of publications among co-workers and sympathisers in the same field that to my mind deserves the highest encouragement. The time has unfortunately gone when scientific investigators can write such delightful and voluminous letters as passed between the research workers of half a century and more ago. The present system of interchange of publications has necessarily taken the place, to a very large extent, of the early letter-writing.

It is as important to make research work known as to do it. To get our friends to read the contributions we may make to science requires nowadays no little skill and diplomacy and an attractiveness of literary style on the part of the author not so essential in the days of less frequent printed works. The original purposes of important and costly expeditions are sometimes well-nigh defeated or superseded, because of the delay in publication, ensuing from the elaborateness of the plan adopted for the reduction of the field results and the form of publication decided upon. Reduction in the pretentiousness, size, and cost of scientific publications appears to me to be one of the greatest needs of research to-day.

Some time could profitably be spent on a consideration of the general agencies engaged in furthering research work and the methods employed for doing so. Being connected with a "research institution," I should consider myself incompetent to enter upon a free and unbiased discussion of the methods of such organisations for the furthering of research work. I will, however, take as an example the general magnetic survey of the earth as representative of the kind of world-embracing research enterprises I have in mind.

Alexander von Humboldt, whose mental grasp was extraordinary in more than one science, set forth the following plan in his "Cosmos" for a general magnetic survey of the globe.[1]

"Four times in every century an expedition of three ships should be sent out to examine as nearly as possible at the same time the state of the magnetism of the earth, so far as it can be investigated in those parts which are covered by the ocean. . . . Land expeditions should be combined with these voyages." . . .

"May the year 1850 be marked as the first normal epoch in which the materials for a magnetic chart shall be collected, and may permanent scientific institutions (academies) impose upon themselves the practice of reminding, every twenty-five or thirty years, Governments, favourable to the advance of navigation, of the importance of an undertaking whose great cosmical importance depends on its long-continued repetition."

Here was a noble project, universally conceded to be not only of the greatest scientific interest, but also of the greatest practical importance. Yet why is it that this grand plan has never been carried out by the foremost nations in friendly concert? Have our academies, as Humboldt suggested, never "imposed upon themselves the practice of reminding every twenty-five or thirty years Governments, favourable to the advance of navigation, of the importance of an undertaking" of this character?

Instead of working along a common and definite plan, the magnetic operations hitherto have consisted of more or less isolated and incomplete surveys, independently undertaken by various nations and distributed over a great number of years. Not even for a single epoch has it been possible to construct the magnetic charts on the basis of homogeneous material, distributed over the greater part of the earth, with some attempt, at least, at uniformity. As to the possibility of constructing the charts, with the aid of similar data, for epochs twenty-five to thirty years apart, as Humboldt had dreamed, this, in spite of the enlightened interest of many countries, is even more remote.

Why should it have remained for a purely *research* organisation to undertake a problem touching so keenly as this on even the so-called sordid, purely practical interests of man? Is it a fortunate fact that Humboldt's fascinating international scheme failed of execution, and that the chief brunt of the work is now being borne by a single organisation? The magnetic work of the Carnegie Institution of Washington has embraced, since 1904, a general magnetic survey of the Pacific Ocean, and land observations have been made in more or less unexplored regions in different parts of the world. The ocean magnetic work is to be undertaken next in the Atlantic Ocean, in 1909, on a specially built vessel, the first of its kind.

It is believed that an effective scheme of operation has been evolved, with the aid of the valuable advice received from eminent investigators. Without danger of giving offence to anyone, it is possible to deal directly with the officials concerned, submitting to them our plans and ascertaining whether they contemplate doing anything similar, and, if so, whether, in case their funds are insufficient, they could suggest some friendly basis of cooperation between their organisation and ours. This plan of action has met with entire success thus far. Duplication, overlappings, and possible jealousies are all avoided; and in countries where no organisation whatever exists to do the work, we are free to go ahead and finish the task in less time than it would necessarily take to get an official action or official consensus of opinion from a large scientific body.

Slow deliberation in terrestrial magnetic work would be disastrous, for the prime reason that the phenomena of investigation in this field of research are continuously

[1] The quotation is from E. C. Otté's translation of the "Cosmos," vol. ii., pp. 719-20.

undergoing change. The time-element in the earth's magnetism, even for a period of a few years, is of such moment as completely to mask the fine, hair-splitting points which would necessarily and rightly have to be raised on some international mode of action, to say nothing of the painful and cumbersome method which would have to be employed to conform with the rules of official correspondence between nations. Many a well and carefully executed magnetic survey in the past has had its full importance for world-wide investigation destroyed because of the possibility of error in the secular variation corrections which must be applied to bring its results up to the date of the later data.

The course pursued by the Carnegie Institution of Washington in conducting the general magnetic survey of the globe is the only way in which this particular project, and similar ones to it, could not only be expeditiously conducted, but also realise the chief objects of the work. This policy, briefly stated, is to make, with the aid of the friendly and harmonious cooperation of all concerned, a rapidly executed magnetic survey of the greater part of the globe, so that a general survey, all-sufficient for the solution of some of the great and world-wide problems of the earth's magnetism, will be completed within a period of ten to fifteen years. At a smaller number of points, selected in consideration of the prime questions at issue, the observations are to be repeated at intervals of five years or less, in order to supplement the rather sparsely distributed magnetic observatory data. Thus the determination of the corrections for reduction of the general work to any specific date is continuously provided for.

The most evident result of all magnetic work in the past is that, for the purposes of a general survey, it is far better to make some sacrifice in accuracy if thereby it is made possible to secure observations at another point. In other words, the errors due to local disturbing conditions are far greater than the purely observational ones. Hence multiplicity of stations rather than extreme accuracy and laborious methods of observation and reduction is the prime requisite.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The general board of studies has approved Prof. E. C. Stirling, F.R.S., and Prof. W. Ridgeway, Disney professor of archæology, for the degree of Doctor in Science.

The council of the Senate has appointed Prof. Biffen as a representative member of the John Innes Horticultural Institution for four years from February 8.

Oxford.—The vacancy in the Waynflete professorship of mineralogy at Oxford has been filled by the appointment of Mr. H. L. Bowman, of New College, who for many years acted as demonstrator under Prof. H. A. Miers.

On Friday, February 12, the hundredth anniversary of the birth of Charles Darwin was celebrated at Oxford by a reception given in the examination schools by Profs. Vines, Poulton, and Bourne. The proceedings were opened by the Dean of Christ Church, acting for the Vice-Chancellor, who was unavoidably absent. In the course of an interesting address on fifty years of Darwinism, Prof. Poulton spoke of the various influences which had moulded Darwin's career, dwelling especially on his early friendship with Henslow, to whom was due what proved to be the turning point in Darwin's life—his appointment as naturalist to the *Beagle*. The support and encouragement given to Darwin by Lyell, Hooker, and Asa Gray, and the vigorous championship of Huxley, were passed in review, special mention being also made of the chivalrous conduct of Wallace in seeking to minimise his own claims as joint discoverer of the principle of natural selection. The famous contest at the meeting of the British Association at Oxford in 1860 was touched upon, and the lecturer took occasion to contrast the matured views which, after being tested during twenty years of reflection and investigation, at last found expression in the publication of the "Origin of Species," with the hasty and ill-informed impressions of Darwin's early critics. Much of the rapid success of Darwin's theory in gaining acceptance at the hands of the scientific world was due to the personality of its author, whose noble qualities of mind and character were shown alike in his dealings with opponents, with friends, and with younger workers in his own subjects. All this work was accomplished in spite of constant bodily exhaustion from ill-health, to which cause the lecturer was inclined to attribute the lack of appreciation of literature and music in later life, which Darwin himself recognised and deplored. No upheaval in the realms of human thought had carried with it more of immediate pathos and of ultimate triumph than the doctrine of organic evolution, now and always to be associated, first and foremost, with the name of Charles Darwin. Among the assembly on Friday were four of Darwin's sons, Mr. William Darwin, Sir George Darwin, Mr. Francis Darwin, and Major Leonard Darwin. Sir George and Mr. F. Darwin briefly addressed the meeting, confirming the account given by Prof. Poulton of their father's genius and character. In the course of the evening a telegram was received conveying "the greetings of Cambridge zoologists, assembled in Darwin's old rooms, to their Oxford colleagues."

Dr. O. V. Darbishire has resigned his lectureship in botany at the University of Manchester.

Prof. Henry A. Miers, F.R.S., principal of the University of London, will present prizes and certificates to students at the South-Western Polytechnic Institute, Chelsea, S.W., on March 12.

The eleventh annual dinner of the Central Technical College Old Students' Association will be held on Saturday, February 20, at the Trocadero. Dr. H. T. Bovey, F.R.S., Rector of the Imperial College of Science and Technology, will be one of the chief guests.

Bowdoin College, at Brunswick, Maine, U.S., has recently received funds amounting to something more than 100,000*l*., given by a former student at the college, Mr. Joseph Edward Merrill, a business man of Boston. A few weeks before his death in January Mr. Merrill transferred a large part of his property to the college, and bequeathed practically all the rest of his estate to the same institution by his will. Bowdoin College, it may be remembered, was the alma mater of Nathaniel Hawthorne, of Henry W. Longfellow, of President Franklin Pierce, of the late Speaker Thomas B. Reed, and of the present Chief Justice of the United States, Melville W. Fuller.

A Bill has been introduced in the Wisconsin Legislature, says *Science*, which proposes to increase the building fund of the University of Wisconsin from 40,000*l*. to 60,000*l*. annually, and to lengthen the period of this appropriation from five to seven years. From the same source we learn that a new industrial fellowship has been presented to the University of Kansas by the Holophane Glass Co. It yields 300*l*. a year for two years, together with 10 per cent. of the profits that may arise from any discoveries made by the student who pursues special study. The fellowship is open to students of any university, but the work will be done in the laboratories of the University of Kansas.

A representative selection from the exhibits in the British Education Section of the Franco-British Exhibition held last year at Shepherd's Bush, London, has been on view at the Belfast Municipal Technical Institute during the past three weeks. Admission was free, and to explain the purport of the exhibition a series of explanatory addresses by educational experts was arranged. The Belfast Library and Technical Instruction Committee is to be congratulated upon securing the loan of these instructive exhibits from the various education authorities concerned, and it is satisfactory to know that the illustrative specimens, collected at the expenditure of much time and trouble by the authorities of the Franco-British Exhibition, are being placed at the disposal of the great educational institutions in our chief centres of population.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 10, 1908.—"The Extension of Cracks in an Isotropic Material." By A. **Mallock**, F.R.S.

Any specified strain in a solid can be represented as a combination of shear and volume extension or compression, and both for volume extension and shear there are limits which if exceeded either cause rupture or leave the material in an altered condition when the stress is removed.

There is, however, no known limit of rupture for the volume compression of solids.[1]

It would be a matter of interest and importance to determine for solids whether, and how far, the existence of one form of strain influenced the limits of the other, whether, for instance, a body subjected to volume extension would require more or less shear to rupture it than when the volume was normal.

This point has not, so far as the author knows, been made the subject of experiment, but for the purpose of this note it is assumed that if a strain which exceeds either of the limits is applied to a solid, rupture will be due to that property of the substance for which the limit is least, and that if the distortion limit is the smaller of the two, breakage will occur at right angles to the lines of greatest extension, whereas if the volume limit is the least the direction of the break will be indeterminate.

If the conditions of strain at the end of the crack are such that material gives way from over-distortion, the fracture will occur in the plane of the existing crack, which will therefore spread continuously, while if the over-dilatation is the origin the breakage may take place in any direction. If at any place the plane of the new fracture cuts the plane of the crack there will be a re-arrangement of stresses, and a relatively considerable length of material will have to be strained before further rupture is possible, and thus the cross-fractures will act as a bar to the further extension of the crack.

It is concluded, therefore, that in materials such as glass or other substances in which cracks spread in nearly constant directions rupture is due to the distortion limit, and that where a crack extends with difficulty in a wandering manner the dilatation limit is the one which has been exceeded.

The rapid alteration of the direction in which fracture takes place may give rise to the fibrous appearance which often shows itself on broken surfaces in such cases.

When the limits for both μ and κ are reached at nearly the same time, a very small change in either, such as might occur in a body nearly, but not quite, homogeneous, would alter altogether the appearance of a fracture.

In this note only isotropic materials are considered, but it seems probable that the same principles might be used to explain the cleavage of crystals.

Challenger Society, January 27.—Sir John Murray in the chair.—Notes on the breeding habits and development of *Littorina littorea*: W. M. **Tattersall**. On changing the water in the aquarium for fresh sea-water, copulation of the periwinkles was readily induced. The eggs are deposited in small capsules shaped like a panama hat, and are not attached, which accounts for their not having been recorded hitherto. Of the four British species of Littorina, *littorea* is exposed only at low spring tides, and is freed as a trochosphere, later becoming a veliger; *obtusata* is generally exposed at ordinary low water, and is freed as a veliger; *rudis* is exposed during the greater part of the day, and is viviparous; *neritoides* lives between the high water of springs and neaps, and is also viviparous. Both in habitat and life-history these four seem to represent stages in adaptation to a land existence.—British Oithonæ: G. P. **Farran**. It was pointed out that they are four in number, and inhabit, respectively, waters of low salinity, ordinary coastal waters, oceanic waters bordering on the coastal area, and purely oceanic waters. Structural modifications accompany the increase in salinity of the different habitats.—The four species of Polycheles from the N.E. Atlantic: S. W. **Kemp**. Notes on their habits and on the structure of the vestigial eye.

[1] This may give an explanation of the difference between malleability and ductility. Under the hammer the strain is a shear combined with volume compression, while in "drawing" the material undergoes shear combined with volume dilatation. In general, a body which is ductile will also be malleable, but the converse need not hold.

Zoological Society, February 2.—Mr. F. Gillett, vice-president, in the chair.—Christmas Island: Dr. C. W. **Andrews**. Attention was directed to the differences in the fauna associated with influx of population.—Preliminary account of the life-history of the leaf-insect, *Phyllium crurifolium*, Serville: H. S. **Leigh**. The leaf-insects occur in the tropical regions of the Old World, and seem partial to insular life. The eggs, which resemble the seeds of certain plants to a remarkable degree, require to be kept in a constantly warm and moist atmosphere to enable them to hatch; they hatch very irregularly, and the period of incubation often extends over three or four months. When young the larvæ are active as compared with older individuals. The metamorphosis is incomplete, and the adult form is attained by a gradual increase in size; fully developed tegmina and wings only appear in the adult condition. The adult females are large and leaf-like in appearance, but the males are much smaller, and not foliaceous.—The mammals of Matabeleland: E. C. **Chubb**.—Pathological observations at the society's gardens during 1908: Dr. H. G. **Plimmer**.

Linnean Society, February 4.—Dr. A. Smith Woodward, F.R.S., vice-president, in the chair.—*Fucus spiralis*, Linné, or *Fucus platycarpus*, Thuret; a question of nomenclature: Dr. **Börgesen**. The purport of the paper was to show that recent statements by Prof. Sauvageau as to the validity of the name *Fucus spiralis*, Linn., are not supported by the history of the plant, nor by specimens in the Linnean herbarium.—Observations on the œconomy of the *Ichneumon manifestator*, Marsham (nec Linn.): an historical note: C. **Morley**. The writer referred to the account given in 1794 by a former secretary of the society, Thomas Marsham, of an insect observed in Hyde Park. Mr. Cockayne found recently in the same place a specimen of *Ephialtes extensor*, Tasch., a Continental species not hitherto noticed in Britain; the paper concludes by pointing out the similarity of the two occurrences, and the difficulty of clearing up the synonymy.—The Polyzoa of Madeira: Rev. Canon **Norman**. For more than forty years the late Mr. J. Yate Johnson was residing at Madeira, and diligently studied both its flora and fauna. He especially devoted himself to the marine fauna, and the Polyzoa did not escape him. From time to time he submitted the species which he found for determination by naturalists who specially worked at this class—first to Prof. Busk after his death to Rev. Thomas Hincks, and subsequently to Mr. Waters. The total number of species found by him was 52; the present paper contains 139. Previous writers on the Polyzoa of Madeira have been unable to give particulars as to the circumstances (habitat, depth, &c.) at which the various species lived. These particulars the author supplies as regards most of the species previously known as Madeiran. With respect to the additions now made, there are some species new to science; others previously known in the Mediterranean; others which have been recently described from the Prince of Monaco's dredgings, and two species the occurrence of which is certainly interesting.

Royal Anthropological Institute, February 9.—Prof. W. Ridgeway, president, in the chair. Dene-holes: Rev. J. W. **Hayes**. It was held that these excavations were merely chalk wells or chambers from which chalk was taken for builders' mortar or for manure for the fields. The author did not contest that all the dene-holes were modern; some may well have been dug in Saxon or even in Roman times, but others were certainly not more than 100 years old, and some were dug within the last quarter of a century. Evidence was adduced to show that even at the present day the farmers in some parts of the country, Hertfordshire, for example, still get chalk for the land from similar pits. The use of chalk for building was enlarged upon, and the author was able to show that the Chislehurst caves were nothing more than an old chalk mine, the so-called altars, or steps, being merely platforms left purposely to enable the workmen to reach the roof of the cavern. The author was also able to show that where

a firm stratum of chalk, suitable for builders' lime, was found under the Thanet sand, it would pay the excavators better to make fresh shafts through the sand than to tunnel in the ordinary way and hoist the material excavated through a single shaft. The cones of sand usually found at the bottom of a dene-hole were explained as the result of the refuse of a new shaft being deliberately thrown down an old one.

Mathematical Society, February 11.—Sir W. D. Niven, president, in the chair.—The conformal transformations of a space of four dimensions and the generalisation of the Lorentz-Einstein principle: H. **Bateman** and E. **Cunningham**.—A certain family of cubic surfaces: W. H. **Salmon**.—Some fundamental properties of a Lebesgue integral in a two-dimensional domain: Dr. E. W. **Hobson**.—The relation between Pfaff's problem and the calculus of variations: Prof. A. C. **Dixon**.—(1) Implicit functions and their differentials; (2) indeterminate forms: Dr. W. H. **Young**.—Modular invariants of a general system of linear forms: Prof. L. E. **Dickson**.

DUBLIN.

Royal Dublin Society, January 26.—Prof. H. H. Dixon, F.R.S., in the chair.—The colours of Highland cattle: Prof. James **Wilson**. Four colours go to the making of Highland cattle. These are:—(1) the original black colour; (2) a brownish-black or blackish-brown, called *donn* in Gaelic; (3) red, introduced by Anglo-Saxon cattle; and (4) light dun, a lighter or silvery-grey, probably introduced from Scandinavia. These four colours by intercrossing produce five others. Black is dominant over red, and so no new colour is produced; but light dun crossed with red produces the hybrid yellow, and crossed with black the hybrid dun (registered as dun and dark dun), while brownish-black or donn produces hybrid brindles with black, red, and light dun.—Note on the tensile strength of water: Prof. H. H. **Dixon**. By using Berthelot's method tensions in water were obtained amounting to more than 100 atmospheres. The range of temperature over which these tensions were observed lay between 25° C. and 80° C. The water used contained large quantities of air dissolved in it. From the nature of the experiments the tensions obtained form a minor limit for the cohesion of air-containing water, its adhesion to the conducting tubes of plants, and its adhesion to glass and copper.—A new process of contact photography: E. E. Fournier **d'Albe**. Photographs are obtained by this process of any full-toned picture, letter-press, or diagram without the use of a camera. The picture is laid on a table with its face upwards, and a sensitive plate, film, or paper is placed upon it, with the film in contact with the picture. Exposure is made by means of light from above through the back of the plate or paper. The result is a faint negative, much fogged. The negative is developed with a view to the utmost "hardness," so as to minimise the fog and bring out the design. This principle is also applied to the positive printed from the negative, and the result is a good reproduction of the original. If necessary, the remaining fog can be cleared by two more reversals, preferably with "photomechanical" plates. The final result is a reproduction in bold black and white, perfectly free from fog and free from defects inseparable from all work done with a lens. It is proposed to call the process "anastatic" photography, by analogy with a disused lithographic process of the same name.

EDINBURGH.

Royal Society, February 1.—Prof. A. Crum Brown, vice-president, in the chair.—Magnetic quality in the homogeneous hexagonal arrangement of molecular magnets: Prof. W. **Peddie**. This was a continuation along the same lines of results already given for cubical arrangements of magnetic molecules.—An improved form of magnetometer for the testing of magnetic materials: J. G. **Gray** and A. D. **Ross**. When the usual east-west arrangement of a magnetising coil with auxiliary coil is used for compensating the direct action of the solenoid on the magnetometer needle, it is very difficult to ensure the accurate alignment of the axes of the two coils so as to be absolutely certain that there is no transverse resultant magnetic force in the north-south direction. In delicate work it is important to get rid of this possible inexact compensation, and at the same time to be sure that when the compensating coil is clamped in position the clamping does not bring in any change. The latter desideratum was attained by using two compensating coils at different distances from the magnetometer, the nearer one being set for rough adjustment, and the more distant one being then used for the fine and exact adjustment for balancing of the east-west fields at the position occupied by the magnetometer needle. The second adjustment was made after the nearer coil was clamped, and the sensitiveness was such that the second coil could be shifted through an appreciable distance without affecting the adjustment. The next step was to test for the existence of a north-south residual force. This was effected by first deflecting the magnetometer needle by means of a small permanent magnet suitably placed. On reversal of a powerful current through the magnetising and compensating coils, which had already been adjusted for east-west balancing, there was in general a change in the deflection, indicating the presence of a north-south component. A third coil was then suitably introduced either north or south of the magnetometer needle, and set in circuit with the other coils. By adjustment of the position of this third coil the change of deflection of the deflected needle, due to reversal of the current, could be wiped out. The small permanent magnet was then removed, and the magnetometer was in accurate adjustment for the purposes of testing magnetic quality. All the essential parts of the apparatus were mounted on a cross-shaped mahogany board, analogous in its broad features to an optical bench. Details were also given for facilitating testing from the temperature of liquid air up to high temperatures.—On the conditions for the reversibility of the order of partial differentiation: Dr. W. H. **Young**.

PARIS.

Academy of Sciences, February 8.—M. Émile Picard in the chair.—Observations of the sun, made at the Lyons Observatory, during the fourth quarter of 1908: J. **Guillaume**. The observations are summarised in three tables, giving the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude. There was a much smaller total area of sun-spots visible compared with the previous quarter (3401 against 7893). Two spots were large enough to be visible to the eye unassisted.—Observations of the conjunction of Jupiter with χ Leo (4·8), made with the Brunner equatorial of the Lyons Observatory: J. **Guillaume**.—The integration of linear systems with a skew determinant: E. **Vessiot**.—The representation of a function with a real variable by a series formed with polynomials figuring in successive differential coefficients of the function e^{-x^2}: M. **Galbrun**.—A new radio-active product of the uranium series: Jacques **Danne**. In the separation of uranium X from 20 kilos. of uranium nitrate, a new radio-active substance was found, apparently the immediate parent of uranium X, for which the name radio-uranium is proposed.—The striæ of oscillating sparks: André **Léauté**. If a condenser is discharged through a coil carrying two layers of wire, the current passing through the coil has been shown by the author in a previous paper to be the sum of two sinusoidal currents. The frequency of the first is practically identical with that resulting from the application of Thomson's formula; the second has a greater frequency, and its existence furnishes a complete explanation of all the facts observed relating to striæ in induction sparks.—The mass of the negative ion of a flame: Georges **Moreau**. In a flame at a temperature of 2000° C. absolute, the mobility of the negative ion was found to be 1170 cm./volt: sec., and the velocity $2{\cdot}5\times10^6$ cm.: sec., the numbers being probably accurate to about 10 per cent. This leads to a value $(1{\cdot}1\times10^{-25})$ gr. as the mass of the negative ion, intermediate between the atom of hydrogen, $(1{\cdot}4\times10^{-24})$ gr., and a corpuscle, $(0{\cdot}75\times10^{-27})$, according to Perrin.—The *rôle* of the dissociation of the carbonophosphates in nature: A. **Barillé**. It has been shown in an earlier paper that carbonic acid combines with the phosphates of metals that are capable of forming bicarbonates, giving rise to easily dissociable compounds, the carbonophosphates. The intervention of these compounds is discussed as regards the formation of certain calculi, the absorption of carbon dioxide by the blood, sediments in urine, and as affecting

the nutrition of plants.—The combinations of gold with bromine: Fernand **Meyer.** The final product of the action of excess of bromine on gold is pure $AuBr_3$. This is soluble in bromine and volatile in an atmosphere of bromine at about 300° C. At temperatures at which $AuBr_3$ dissociates, two bromides only appear to exist, $AuBr_3$ and AuBr, the dissociation curves of which have been studied. There is no evidence of the existence of $AuBr_2$.—The coking power of coals: O. **Boudouard.** Coal was extracted with various organic solvents, of which only one, pyridine, dissolved an appreciable amount. The coking power of the extracted coal was unaffected.—Indigoid colouring matters derived from phenyl-isoxazolone: A. **Wahl.**—The chemical composition of colloidal silver: G. **Rebière.** A study of the electrical conductivity of solutions of colloidal silver prepared by Bredig's method leads to the conclusion that a part of the silver is in solution as oxide, or possibly carbonate.—The fertilisation of the poppy flower: Paul **Becquerel.**—The presence of amylase in old seeds: MM. **Brocq-Rousseu** and Edmond **Gain.** Wheat, fifty years old and incapable of germination, still contains diastases capable of transforming starch into sugar.—The gastric digestion of human milk and asses' milk: Louis **Gaucher.** The casein of these milks resembles that of cows' milk in not being peptonised in the stomach. Their great digestibility is due to the casein forming very small clots in the case of human milk, or a clot very easily broken up in the milk of the ass.—Parasitic protozoa of the intestine of the lobster: L. **Léger** and O. **Duboscq.**—The regeneration of the anterior part of the body in the Chetoptera: Ch. **Gravier.**—Some Plumulariidæ of the British Museum collection: Armand **Billard.**—A new protozoa from *Ctenodactylus gondi*: C. **Nicolle** and L. **Manceaux.**—The chemical treatment of bile. The separation of the biliary acids: M. **Piettre.** —The hypotensive action of d'Arsonvalisation in permanent arterial hypertension: M. **Letulle** and A. **Moutier.** The arterial pressure in these experiments was measured for each case with two independent instruments of different construction; the figures obtained were practically identical. The treatment with high-frequency current always caused a reduction in the arterial pressure. —Antimony in syphilis: Paul **Salmon.** Antimony in the form of tartar emetic is of service in the cure of syphilis, but in certain cases there is a rapid relapse.—The geology of Agôoué: M. **Arsandaux.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 18.

ROYAL SOCIETY, at 4.30.—On the Osmotic Pressures of Calcium Ferrocyanide Solutions, Part II., Weak Solutions: Earl of Berkeley, F.R.S., E. G. J. Hartley and J. Stephenson.—On the Spontaneous Crystallisation of Monochloracetic Acid and its Mixtures with Naphthalene: Prof. H. A. Miers, F.R.S., and Miss F. Isaac.—An Apparatus for Measurements of the Defining Power of Objectives: J. de G. Hunter.—On Best Conditions for Photographic Enlargement of Small Solid Objects: A. Mallock, F.R.S.

ROYAL INSTITUTION, at 3.—Problems of Geographical Distribution in Mexico: Dr. Hans Gadow, F.R.S.

LINNEAN SOCIETY, at 8.—Discussion on Alternation of Generations: opened by Dr. W. H. Lang.

FRIDAY, FEBRUARY 19.

ROYAL INSTITUTION, at 9.—Recent Advances in Means of Saving Life in Coal Mines: Sir Henry Cunynghame, K.C.B.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting. —*Further discussion*: The Filtration and Purification of Water for Public Supply: John Don.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Standardisation in Engineering Practice: Dr. W. C. Unwin, F.R.S.

MONDAY, FEBRUARY 22.

ROYAL SOCIETY OF ARTS, at 8.—Modern Methods of Artificial Illumination: Leon Gaster.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A Recent Journey Across Northern Arabia: Captain S. S. Butler.

INSTITUTE OF ACTUARIES, at 5.—Some Financial and Statistical Considerations of the Old Age Pension Scheme: Vyvyan Marr.

TUESDAY, FEBRUARY 23.

ROYAL INSTITUTION, at 3.—The Evolution of the Brain as an Organ of Mind: Prof. F. W. Mott, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Man and the Glacial Period: W. Allen Sturge.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: The Design of Marine Steam-Turbines: S. J. Reed.—*Probable Paper*: Some recent Grain-handling and Storing Appliances at the Millwall Docks: M. Mowat.

WEDNESDAY, FEBRUARY 24.

ROYAL SOCIETY OF ARTS, at 8.—Hand-made Papers of Different Periods: Clayton Beadle and Henry P. Stevens.

GEOLOGICAL SOCIETY, at 8.—Palæolithic Implements, &c., from Hackpen Hill, Winterbourne Bassett, and Knowle Farm Pit (Wiltshire): Rev. H. G. O. Kendall.—On the Karroo System in Northern Rhodesia, and its Relation to the General Geology: A. J. C. Molyneux.—On Coal-Balls from Japan: Dr. Marie C. Stopes.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

SOCIETY OF DYERS AND COLOURISTS, at 8.—A Series of Azo-dyes derived from the Aminosulphonamides: Dr. G. T. Morgan and Frances M. G. Micklethwaite.

THURSDAY, FEBRUARY 25.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Statistical Form of the Curve of Oscillation for the Radiation emitted by a Black Body: Prof. H. A. Wilson, F.R.S.—The Flight of a Rifled Projectile in Air: Prof. J. B. Henderson.—On the Cross breeding of Two Races of the Moth *Acidalia virgularia*: L. B. Prout and A. Bacot.

ROYAL INSTITUTION, at 3.—Problems of Geographical Distribution in Mexico: Dr. Hans Gadow, F.R.S.

ROYAL SOCIETY OF ARTS, at 4.30.—The Bhuddist and Hindu Architecture of India: Prof. A. A. Macdonell.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Further discussion*: The Use of Large Gas Engines for Generating Power: L. Andrews and R. Porter.

FRIDAY, FEBRUARY 26.

ROYAL INSTITUTION, at 9.—Osmotic Phenomena, and their Modern Physical Interpretation: Prof. H. L. Callendar, F.R.S.

PHYSICAL SOCIETY (at Finsbury Technical College, Leonard Street, City Road, E.C.), at 5.—A Laboratory Machine for applying Bending and Twisting Moments simultaneously: Prof. Coker.—On the Self-demagnetising Factor of Bar Magnets: Prof. Silvanus P. Thompson, F.R.S., and E. W. Moss.—Exhibition of Optical Properties of Combinations of Mica and Selenite Films (after Reusch and others) in Convergent Polarised Light: Prof. Silvanus P. Thompson, F.R.S.—Exhibition of Apparatus: C. R. Darling.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Standardisation in Engineering Practice: Dr. W. C. Unwin, F.R.S.

SATURDAY, FEBRUARY 27.

ROYAL INSTITUTION, at 3.—Properties of Matter: Sir J. J. Thomson, F.R.S.

CONTENTS.

THURSDAY, FEBRUARY 25, 1909.

THE NATURAL HISTORY OF CONDUCT.

The Origin and Development of the Moral Ideas. By E. Westermarck. In 2 vols. Vol. ii. Pp. xv+852. (London: Macmillan and Co., Ltd., 1908.) Price 14*s.* net.

THE present volume completes Prof. Westermarck's work, which is likely to remain for a long time a standard repertory of facts, which the moralists of every school will, no doubt, set themselves to interpret, each after his own fashion. *Hic liber est in quo quaeret sua dogmata quisque,* and it is as a tribute to the author's erudition and fulness of matter that I hasten to add that the second half of the distich is also likely to be fulfilled; there are few schools of moralists who will not find something to their taste in this vast repertory of information about the moral codes and practices of mankind. The practices and beliefs of different races and ages with respect to the rights and duties of property, regard for the truth, concern for the general happiness, suicide, sexual relations, religion, and the supernatural generally, such are only a few of the topics with which Prof. Westermarck deals, and he deals with none of them without producing masses of significant fact for which, apart from his aid, the student of moral ideas and institutions would have to search hopelessly through the whole literature of anthropology. Merely to have done so much, even if Prof. Westermarck had gone no further, would have been to establish an inextinguishable claim on the gratitude of his readers, but it need not be said of the author of the "History of Human Marriage" that he has attempted to do much more. His aim, at least, is not merely to record the facts and classify them, but to offer a philosophical interpretation of them, to put forward a definite theory of the "origin" and "development" of the ethical side of human thought. It is quite out of the question for a single reviewer, who is not even an anthropologist, to presume to pronounce a summary judgment upon the success with which the task has been executed, and the present writer would therefore be understood to be attempting nothing more than the utterance of one or two of the reflections suggested to one interested reader by Prof. Westermarck's book.

In one respect, the work before us, even if attention were confined to the present volume alone, is less fortunate than the book by which the author made his great reputation as an anthropologist years ago. The "History of Human Marriage" was not merely a great collection of interesting facts; it had a very definite thesis, which was kept in view from the very first, and of which the reader was never allowed to lose sight for long, and that thesis had the further attraction of being, in the then state of anthropological speculation, a novel one. The present work has also, of course, its thesis, but it is one which is, for the greater part of the time, obscured by the very masses of detailed fact which are marshalled in support of it. Perhaps there never was a book in which it was harder to see the wood for the trees, or from which it would be easier to carve out whole monographs on connected groups of moral practices which seem to have no special bearing on the author's or any other man's theory of the fundamental character of moral action and the moral judgment. The main thesis, when one reaches it, is, perhaps, also a little disappointing. In essentials, it seems to contain nothing which is not already familiar to the student of so old-established a moralist as Hume, except, perhaps, the employment of the expression "altruistic" sentiment, in the sense of pleasure or pain awakened by our consciousness of the pleasure or pain of others, and this, again, is familiar to us from Comtism. Briefly put, the author's position is that the moral concepts (good, bad, right, wrong, and the rest) are based on "moral emotions," and that *moral* emotions (the sense of approval and censure) are retributive in character, censure being akin to revenge, approval to gratitude. These emotions themselves are things which "have been acquired by means of natural selection in the struggle for existence." A censorious critic would probably remark that, so far as regards the "origin" of the moral judgment, this theory leaves us just where it found us. "Natural selection," even if we allow it all the significance which has been claimed for it by the ultra-Darwinians, can, at best, account for the preservation of a favourable variation when it presents itself. Prof. Westermarck almost seems to invoke it to account for the variations it preserves. It is more to my purpose, however, to urge that the reduction of all moral judgments to the expression of "retributive" emotion seems only possible if we confine morality to the class of acts which are directly approved or blamed on account of their effect on some being other than the agent. If we do this, we are led at once into a breach with unsophisticated moral opinion. *E.g.* such opinion would pronounce it absurd to hold that a prudential regard for one's own future, a devotion to one's own physical and mental improvement, are not valuable moral qualities.

I note that Prof. Westermarck seems at times inclined to admit these, and even more startling, paradoxes. He habitually distinguishes between "prudential" and moral considerations, as if the same set of reasons for choosing a line of conduct might not fall under both heads at once, and, in one place, he even seems to suggest that we have no right to condemn two adults who choose to commit sodomy, on the ground that their behaviour hurts no one but themselves. (At least, he writes sympathetically of this doctrine, p. 483.) The example suggests a further criticism on the author's general philosophical standpoint. As it sufficiently shows, he really leaves no place in his system for a reasoned desire to promote the good of others, as distinct from an amiable tendency to enjoy witnessing their pleasure. Now it seems undeniable th t the actual production of pleasure in others is only a very subordinate element in the kind of good which persons of ardent philanthropic zeal, without any preconceived theory of ethics, believe it their duty to promote. Just as I am conscious that pleasure, as such, is only a minor element

in the good I desire for myself, so I am conscious that it is only a minor element in the good I believe it my duty, say, as a father to promote for my child; and, as I say, I believe this conviction to be shared by the generality of high-minded men who are not pre-committed to any particular scheme of moral philosophy.

It may, no doubt, be said that the view is a mistaken one, but at least it is there, and it is a serious defect in a proposed analysis of actual morality that it leaves no way of accounting for the fact. Where Prof. Westermarck, if I may say so without presumption, goes wrong is in directing his attention primarily to the kinds of emotion which accompany moral judgments instead of attempting to study just the general character of the conduct upon which the judgments are passed. As Mr. Bradley put it long ago, with reference to J. S. Mill's account of poetry, "Anything in the way of shallow reflection on the psychological form rather than an attempt to grasp the content." It is the same undue preoccupation with psychological form as opposed to ethical content, as it seems to me, which makes Prof. Westermarck's attempts to trace and forecast the development of moral belief and practice disappointing. He has little that is suggestive to say about the actual development of the moral ideal within the history of civilisation; indeed, about the oldest and perhaps the most influential of still existing moral institutions, the Christian Church, he always writes with a lack of appreciation which might fairly have been blamed in an eighteenth-century *illuminé*, though one would have expected that, in its Catholic form, it would have appealed to him in virtue of its "cosmopolitanism." The chief prophecy he makes as to the future is that "the altruistic sentiment will continue to expand." Whether this is a prophecy of good I am not sure. No doubt it is, if it means that devotion to a common good is to become a more prominent factor in all our action. If it means that devotion to definite organisations for social life is to be replaced by aimless amiability towards the human race in general, there may be reason to doubt whether the substitution would be in the direction of genuine progress.

A. E. TAYLOR.

POPULAR ELECTRICITY.

Electricity Present and Future. By Lucien Poincaré. Translated by Jasper Kemmis. Pp. viii+315. (London: Sisley's, Ltd., n.d.) Price 7s. 6d. net.

THE title of this book is certainly a misnomer, and any reader expecting therefrom to find the volume largely occupied with a prophecy of the future development of electricity is destined to be disappointed. Had the book been called "Electricity Past and Present," the subject-matter would have been much more correctly indicated, as a fair amount of historical matter is combined with the description of the present state of applied electricity. Regarded simply as a popular exposition of this state, the work has much to recommend it, but it is, perhaps, hardly fair to the author's intentions to look on it simply in this light. From the preface one gathers that the intention has been to trace the tendencies observable in recent developments in electrical engineering, and to produce a work, to use the author's own words, "not unworthy a place in a collection of studies in scientific philosophy." Candidly, we must admit that we are not impressed with the "scientific philosophy" of the book, unless, indeed, it is philosophy to show how the simpler forms of machines and apparatus have been modified to suit the varied requirements of modern industry.

The first part of the book is occupied with theoretical matters, the main outlines of the theory of magnetism and of induction being clearly expounded. Then follow two chapters on generating machines and motors, a fairly long chapter on the transmission of energy, and finally two short chapters on electrochemistry and electric lighting. These chapters form the main portion of the book; they are clearly written, and give a clear and interesting account of the subjects with which they deal. We cannot help thinking that the addition of a few simple diagrams and illustrations would greatly assist the explanations of some of the more complicated points; the reader whose knowledge of electrical technology is not very extensive is likely to find some of the passages difficult to follow. Indeed, we think the whole book, excellent though it is in many respects, would be greatly improved by simplification and a frank abandonment of the philosophic aims which have helped to inspire it, and which have given rise, we think, to such defects as it possesses. Amongst such defects may be noted certain peculiarities of style which are apparently attempts to give the book a literary value, but which, in our opinion, have just the reverse effect. To quote one or two examples, we read, on p. 38, "M. Warburg justly claims the distinction of having been the first, in 1880 . . ." when we suppose all that is meant is that M. Warburg *has* the distinction, &c. On the same page a sentence referring to Ewing's work on hysteresis is immediately followed by a paragraph opening, "This same Ewing studied in all their complex details these phenomena." Why not say Ewing studied these phenomena in all their complex details? Instances could be multiplied almost indefinitely, but we will content ourselves with one other quotation. On p. 27 we read:—

"However, notwithstanding the high respect entertained for the ventures of this great scientist (*Faraday*), whose experiments were the most original and productive that science had seen in the nineteenth century, and notwithstanding the lucidity of his 'Experimental Researches in Electricity,' one cannot but feel surprised, even shocked, at the methods he employed in describing matters which are not in consonance with the conventional forms of mathematical symbols."

We are not quite sure what is the meaning, if any, of the last sentence, and whether it is the "methods" or the "matters" which offend; but assuredly the criticism is most unjust, and the author (or is it the translator?) could not do better than study that simplicity of language which enabled Faraday to confer such "lucidity" on his writings. After all, M. Poincaré is attempting a similar task in

this book in endeavouring to present the position of electrical theory and practice by methods "not in consonance with the conventional forms of mathematical symbols."

There is one matter to which we feel we must refer in conclusion, though it does not affect the general merits of the book. Surely never was an index more curiously compiled since someone wrote, "Mill, on Liberty: do., on the Floss" in a book catalogue. What can be said of such entries as these? "Both fields interdependent," as a reference to the interdependence of the electric and magnetic fields; "First Consul's opinion"; "Electricity, mystery of, 4; physicists cannot explain, 5; contingencies increase, 6; reason obvious, 7"; "Whence mechanical work?" If the rest of the index were comprehensive and well-arranged, such peculiarities might be excused as, possibly, intentionally humorous; but unfortunately such is not the case. Thus arc lamps are indexed under "Lamps, arc," but incandescent lamps under "Incandescent," and there are no cross-references. Also, in the preface a full list of the names referred to in the book is promised in the index, but the majority are not to be found there.

MAURICE SOLOMON.

THE CAUSES OF MUTATION.

Mutation et Traumatismes, Etude sur l'Evolution des Formes végétales. By L. Blaringhem. Pp. 239; 8 plates. (Paris: Félix Alcan, 1908.) Price 10 francs.

ACCORDING to the mutational view of evolution, the kind of variations to the survival of which specific differentiation is due are not such differences between individuals as are always afforded, in any large collection, by fluctuating variability; but variations of an entirely different nature, which de Vries has called mutations. These mutations are not, as repeatedly stated, larger differences than those which are due to fluctuating variability. On the contrary, the differences between the extreme variants of fluctuating variations are often so large that they cannot escape the notice of the most unobservant; whereas the difference between the new types (especially when these are elementary species, and not varieties) which arise by mutation are often so subtle that they can often only be detected by an observer with an intimate familiarity with the species in question.

The great difference, according to de Vries, between these two types of variation is that the maintenance of any new stage which has been reached by the selection of the extreme variants of fluctuating variability is dependent on the continuation of the selection which produced it, whereas the new types which arise by mutation are independent of selection. Of course, if the new types are sickly or are characterised by the acquisition of new characters which interfere with their attainment of maturity they very soon cease to exist. The point is that the origin of the new type on the latter view is independent of selection, whilst on the former it is due to it; and this holds good for the origin of new types in a state of domestication as well as in wild nature. The new form "is seen to be very good after, not before its creation."

But perhaps the most striking difference between the two kinds of variation is that fluctuating variability is exhibited by all animals and plants at all times, whereas mutability appears to be exhibited only very rarely. Indeed, de Vries only found one plant which appeared to be in this state (Œnothera), although he tested a large variety of plants for the purpose. Now, if it is true that evolution is due to the differences presented by mutability, we naturally want to know to what these mutable phases are due; and it is a paradoxical fact that de Vries should have discovered a great deal about the causes of fluctuating variability and next to nothing about those of mutability. A great many of the differences which are classed as fluctuating can be attributed with great certainty to differences of nutrition, and there is a long series of facts (in connection with the limit attainable by the selection of such variations) which go to support this explanation.

Of the causes of mutation little is certainly known, though it is generally held that the inception of a mutable phase is caused by some disturbance of that equilibrium in the germ-plasm which expresses itself in the stability of a species which is not in a mutable state. Indeed, the generality of a belief in that form of variation which has since been called mutation, and of this view, as to the cause of it, is witnessed by the existence of a special French word, "affoler," to express the process by which this disturbance of the equilibrium may be effected. The term "affolement" is also used by gardeners to signify the state which this brings about, in other words, the mutable phase itself. The book before us is an account of a long series of experiments which M. Blaringhem has conducted on the effect of mutilations on the maize and other plants. He finds that the buds which are produced after such mutilation (such as severing the stem) bear a far larger number of abnormal organs —stems, leaves, flowers, and fruits—than do normal unmolested plants; and, moreover, that amongst the offspring of mutilated plants there occur (1) considerable monstrosities; (2) plants which have recovered the ancestral equilibrium; and (3) very occasional slight anomalies which constitute varieties and are perfectly new and constant.

M. Blaringhem has come in touch with the outskirts of an extremely interesting problem, namely, the effect of the rate, at which vital processes take place, on their normality. It may be that the luxuriance of life in the tropics is due to the speed at which ontogenetic processes take place there; if heat increases the rate at which growth takes place (as it is known to), and increased speed leads to increased variability, the luxuriance of tropical life may be simply due to wide range of variations placed at the disposal of natural selection to operate upon. Similarly the enormous speed at which growth proceeds in buds produced on plants which have been cut down to the ground may be the sole cause of the increase in the number of monstrosities produced by them. Here is matter for investigation, the results of which ought

to be of the greatest interest and value. M. Blaringhem's account of his experiments forms a stimulating starting-point to such an inquiry, and should be read by everyone engaged in the experimental study of vital processes.

THE SUBJECT-MATTER OF ANTHROPOLOGY.

The Scope and Content of the Science of Anthropology. By Juul Dieserud. Pp. 200. (Chicago: The Open Court Publishing Co.; London: Kegan Paul, Trench, Trübner and Co., Ltd., 1908.) Price 8s. 6*d.* net.

A PERUSAL of this book will convince most people that the terminology and classification of the subject-matter of anthropology is at present in a state of almost hopeless confusion. In England, early authorities like Hunt defined anthropology as the science of the whole nature of man, including the study of his anatomical, physiological and psychological characters, and this logical view has fortunately been maintained among the majority of anthropologists in this country up to the present day. In France also the original view, as expressed by Pruner Bey, was that anthropology embraces the study of man in time and space, and the great Broca took a very similar view of the scope of the science. In Germany, however, a beginning of the descent from this clear and reasonable definition of the science appears to have been made in 1879 by Müller, who divided anthropology into (1) physical anthropology and (2) psychic anthropology, and this cleavage was made wider by Grosse, who in 1894 completely separated the second of Müller's subdivisions from anthropology and gave it a new designation, namely, ethnology, or the culture of races.

Ethnology and its related term ethnography were henceforth widely applied, chiefly in Germany and America, to a new science dealing with the culture of races. It was excluded from the science of anthropology, chiefly, no doubt, because this study had increased more rapidly than other departments of anthropology, its material data being represented by large collections of tools, weapons, dress and pottery in museums, and its psychic data by numerous memoirs on manners and customs, religion and folklore. From a logical point of view it is difficult to see why the study of the psychological evolution of man, as expressed by the various products of his activity, should be excluded from anthropology—the science of the whole nature of man—and it is still more difficult to see why the term ethnology, which etymologically means the science of peoples or races, should be applied to this new science, for which the proper designation would appear to be that given to it by Achelis, namely, psychical anthropology.

This confusion in the terminology of anthropology is, however, now so widespread that it will take a long time to set it right, and Mr. Dieserud's book will, we fear, only tend to perpetuate the confusion. He shows himself throughout strongly in favour of the misuse of the term ethnology by excluding from its scope all somatic or physical anthropology, though he very illogically compromises between reason and use, or rather abuse, by admitting physical subject-matter under the allied term ethnography.

The second part of Mr. Dieserud's book consists of a scheme of library classification for works on anthropology. He divides the subject into three main classes, namely, (1) general, (2) somatology or physical anthropology, and (3) ethnical anthropology. The second and third classes are further subdivided, and a comparison of some of these subdivisions will give some idea of the consequences of the irrational classification of anthropology which the author has adopted. For example, under class (2) we have a subdivision "racial psychology," and under class (3) a subdivision "ethnical or folk-psychology." The plain man will find it very difficult from the names to discover any difference between the two subclasses. There appears to be a great amount of apparent overlapping in other subclasses; for example, it is difficult to distinguish between palæoanthropology and palæoethnology or archæology, and yet these are separate and distinct subdivisions.

In the details of the physical anthropology section of his classification, the author evidently owes a great deal to the excellent scheme of Prof. Martin, of Zürich, and where he departs from this it is not often by way of improvement.

The subdivision of his third class, "ethnical anthropology (or psycho-socio-cultural anthropology)," is very minute, but apparently here also we have redundancy; for example, "gambling and its implements" and "gambling implements" are two different subdivisions, one of which appears to be unnecessary.

Part iii. of this work consists of a bibliography containing a list of a few important works on anthropology, with notes of their contents, and a list of the chief publications of leading anthropological societies and museums.

Though we cannot recommend Mr. Dieserud's scheme of classification either to librarians or anthropologists, his book is well worth reading, and contains much material that is of great value to the anthropologist who is interested in the question of the scope and content of his science. J. G.

REFRIGERATION.

The Mechanical Production of Cold. By J. A. Ewing. Pp. x+204; illustrated. (Cambridge: University Press, 1908.) Price 10s.

LOW temperatures are rapidly becoming of great industrial and scientific importance, so that the general principles of their application are necessary or useful to continually increasing numbers of people. In this book Prof. Ewing has brought the Howard lectures, which he gave to the Society of Arts in 1897, up to date in various directions by the addition of sections on the more important developments in the last ten years. In these attention is paid to such questions as the production of oxygen by the rectification of liquid air and the theoretical investigations

which lead to the calculation of the efficiency of refrigerating engines.

Starting with the conception of a refrigerating engine as a heat pump which requires the expenditure of mechanical energy to bring heat from a lower to a higher level of temperature working on a reversed Carnot's cycle, the significance of indicator and entropy diagrams is explained in non-mathematical language. The thermodynamical details are worked out more completely in various appendices. These include discussions of entropy (ϕ) diagrams, with either temperature or thermodynamic potential (i) as the other coordinate. A reproduction on a large scale of Dr. R. Mollier's ϕ-i diagram for carbon dioxide is given at the end of the book, and its usefulness in tracing the exact behaviour of an engine using this as working substance is shown. There are also tables of the properties of ammonia, sulphur dioxide, carbon dioxide, and water vapour which would be necessary in such calculations. All these data are given in C.G.S. units, and it is to be regretted that these have not been used throughout the book so as to make it more uniform, and also because there is a strong opinion now that either C.G.S. or some derived units founded on them would be used internationally in applied thermodynamics with the same advantage as they have been in applied electricity.

Absorption and air-compression machines are now only employed in special cases, but they are interesting, and are considered in the second and third chapters.

At the present time, nearly all new installations use the vapour-compression system to which the fourth chapter is devoted. The substances which are used are water vapour, which is clearly only applicable in very special cases, carbon dioxide, sulphur dioxide, ammonia, and methyl chloride. Each of these has special applications, determined by size or danger of explosion, or the unwholesome nature of the gas, in addition to their efficiencies as working substances. It is shown that the theoretical efficiencies increase in the order given with the exception of the last, which is only just mentioned, although it is employed in well-known cascade installations, and is coming into use largely as a convenient substance for small portable machines on rail-road cars and similar places. This chapter, in connection with the following sections devoted to the testing of refrigerating machines, especially by the Munich method, should be of considerable use to students and other workers in this field. Short accounts follow of the principal applications of moderate cold in industries such as brewing and others depending on fermentation processes, also in ice-making, and in the preservation and transport of food and other perishable articles. A section is devoted to the cooling of magazines in ships of war, about which the author writes with special authority.

The remainder of the book discusses the production and application of very low temperatures, such as those obtained by liquid air, liquid hydrogen, and now quite recently by liquid helium. There are three principal methods of reaching these low temperatures, which are all described: the cascade of Cailletet and Pictet, the expansion method of Siemens and others, and the combination of the cooling due to throttling and the regenerative principle by Linde. The main industrial application is for the production of oxygen from liquid air, which is obtained by the Linde process or by the modification of this introduced by Claude, in which the Siemens principle is combined with it. There are considered in detail, and it is shown how the rectification is carried out so that nearly pure nitrogen, as well as nearly pure oxygen, is obtained by the same process. Dewar's work on hydrogen follows, with a *résumé* of its properties and a mention of those of liquid helium.

The book is well illustrated with diagrams and drawings, and has a good index. F. H.

OUR BOOK SHELF.

Principles and Methods of Physical Education and Hygiene. By W. P. Welpton. Pp. xix+401. (Cambridge: University Tutorial Press, Ltd., 1908.) Price 4*s.* 6*d.*

THIS book is addressed to the teachers of elementary schools, and to such of them as enjoy the study of physiology much pleasure will be derived from the perusal of every chapter. The author, we see, is master of method in the University of Leeds; he describes methods as well as theory of cleanliness, ventilation, care of the eye, and such "first aid" as is likely to be called for. More theory than method, however, is set down to advance the practising of the physical exercise part of physical education. We have no idea how the author would arrange to get the best use out of the school playground; how he would attain some organisation of games among scholars without encroaching upon the teacher's time.

"Glycogen" is referred to seven times in the index, but one can find no list of games or activities that suit the different periods of school life, such as would be helpful to the organiser of physical education; accordingly one regrets that theory dominates this work. We are apt to forget that our professional trainers of athletes have been very successful in their way, and with them athletics called the trainers into being; a development of play is the first step towards bettering physical education.

Everyone interested either in games or physical education in its fuller aspect will be delighted with the chapter on the history of physical education, contributed by Prof. J. Welton, with quotations such as that from Lucian on the Athenian boy. "When he has laboured diligently at intellectual studies and his mind is sated with the benefits of the school curriculum, he exercises his body in liberal pursuits, riding or hurling the javelin or spear. Then the wrestling school with its sleek oiled pupils labours under the midday sun, and sweats in the regular athletic contests. Then a bath, not too prolonged; then a meal, not too large, in view of afternoon school. For the schoolmasters are waiting for him again, and the books which openly or by allegory teach him who was a great hero, who was a lover of justice and purity. With the contemplation of such virtues he waters the garden of his young soul. When evening sets a limit to his work, he pays the necessary tribute to his stomach and retires to rest to sleep sweetly after his busy day." Education in this breadth and spirit, lost in the dark ages—for the exercises of chivalry do not represent it—was revived in Italy at the Renaissance, and the first English exponents of this revival—Mulcaster, 1581, and Sir Thos. Elyot, 1531—had their influence dominated by the Puritanism

of those and later times. Perhaps the latter spirit is still effective, as cricket is apparently never played on Sunday.

The neglect of physical education up to the time of Rousseau is sketched by Prof. Welton, and its advance since then in secondary schools. He tells us with regard to elementary schools that the conception of education that guided the Education Act of 1870 was essentially the scholastic tradition, that education and instruction are synonymous, and he affirms the most crying need in English education of to-day to be adequate provision for physical training. H. R. B.

Bathy-orographical Map of the British Isles. Natural Scale 1 : 875,300, or 14 miles to an inch. *Bathy-orographical Map of South America.* Natural Scale 1 : 6,150,000, or 97 miles to an inch. Constructed and engraved by W. and A. K. Johnston, Ltd. Prices not stated.
Handbook to accompany the Map of the British Isles. Pp. 32. Price 6*d*. net.

No more convincing indication could be found of the improvement which has taken place in recent years in the methods of geographical instruction in schools than the enterprise shown by publishers in the production of good orographical maps, both in atlases and on a large scale for class-teaching purposes. The present wall-maps are good examples of the excellent aids which are available to assist teachers in demonstrating the fundamental importance of the distribution of the highlands and lowlands of the areas being studied. In the map of the British Isles six shades of brown are employed to show graphically the course of important contours on the land, and two shades of blue indicate the 20- and 50-fathom lines in the surrounding seas. In the case of South America the varying heights of the land above sea level are depicted by five shades of brown and two of green, while the 100-, 1000-, and 2000-fathom lines are shown on the oceans. Care has been taken to avoid crowding, and the maps are models of clearness.

The "Handbook" should prove a great help to those teachers of geography who have had little experience in teaching their subject by modern practical methods.

Invariants of Quadratic Differential Forms. By J. E. Wright. Pp. vi+90. Cambridge Tracts in Mathematics and Mathematical Physics, No. 9. (Cambridge: University Press, 1908.) Price 2*s*. 6*d*. net.

This number of the Cambridge Tracts deals with a clear and definite problem, the simplest case of which may be stated as follows. Let a, b, c be given functions of the independent variables, x, y, and let

$$adx^2 + bdxdy + cdy^2$$

become

$$\alpha d\xi^2 + \beta\gamma d\xi d\eta + d\eta^2$$

by a change of variables from (x, y) to (ξ, η); what functions of a, b, c and their differential coefficients transform into the same functions of α, β, γ and their differential coefficients? The importance of this inquiry begins to appear in Gauss's celebrated memoir on the deformation of surfaces; and a very large part of what is called the differential geometry of surfaces is, from another point of view, the invariant theory of a quadratic differential form in two variables. In the general theory there are n variables, and the first great step in this direction was taken by Riemann; references to his principal successors are given by Prof. Wright (pp. 5–8). The methods explained in the tract are those of Christoffel, Lie, and Maschke; the last, which is symbolical, and quite recent, is only very briefly summarised, but enough is done to show its interesting character. Another special calculus applied to the subject is that of Levi-Civitā and Ricci (pp. 20–8); and other manipulative devices may doubtless be discovered. So far as one can see at present, the essential elements of the theory are the Riemann-Christoffel four-figure symbols; while the broadest aspect of it is presented by Lie.

Pp. 51–90 give various geometrical and dynamical applications, concluding with the representation of one manifold on another with correspondence of geodesics. Besides being a useful guide to the analytical theory, this tract will be of service to readers of Darboux's and Bianchi's works on the theory of surfaces.

G. B. M.

A Course of Plane Geometry for Advanced Students. Part I. By C. V. Durell. Pp. xi+219. (London: Macmillan and Co., Ltd., 1909.) Price 5*s*. net.

This is a really capital book for students of what may be called scholarship standard. It contains, among other things, sections on similarity, transversals, vector geometry, inversion, and coaxal circles. As examples of the author's choice of elegant methods, and his clearness of exposition, may be taken the proof (due to Mr. Hillyer) that the centres of the diagonals of a complete quadrilateral are collinear (p. 118), and the proof of Feuerbach's theorem by inversion (p. 149). In the latter example, as in many others, teachers will notice the excellence of the diagrams, which give, without confusion, all that is required and no more. There is a practically inexhaustible stock of examples, with a very wide range of difficulty. Mr. Durell is a master at Winchester College, and those who remember the late Mr. Richardson's success in making his boys like and learn geometry will be glad to see that there is no risk of the subject being neglected now that he is gone.

The Contents of the Fifth and Sixth Books of Euclid. By M. J. M. Hill. Second edition. Pp. xx+167. (Cambridge: University Press, 1908.) Price 6*s*. net.

This is a new work rather than a new edition. Prof. Hill has now completely abandoned Euclid's treatment of proportion as given in his fifth and sixth books, and replaced it by an arithmetical theory. Two commensurable quantities, pA, qA, are *defined* as having the ratio p/q. Equal ratios are *defined* as those between which no rational fraction lies. The theory is now made rigorous by means of Dedekind's treatment of irrational numbers, the Cantor-Dedekind axiom, and the axiom of Archimedes. It is a foolish man that never changes his mind; and Prof. Hill's deliberate change of method after eight more years of teaching is a fact to which special attention should be directed.

The Elementary Dynamics of Solids and Fluids. By Prof. W. Peddie. With Sectional and General Examples by J. D. Fulton. Pp. xii+188. (Edinburgh and London: Oliver and Boyd, 1909.) Price 2*s*. 6*d*.

This little book is intended for use by junior students in university classes, and for boys in the higher forms of secondary schools. The treatment is very elementary, and fluids are disposed of in the concluding three of the thirteen chapters. The wisdom of printing answers immediately after the exercises throughout the book may be doubted. As an introduction to dynamics, the book should prove useful.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Brilliancy and Intensity of the Cupric Chloride Flame Spectrum.

IN the account of an interesting investigation of the flame spectrum of cupric chloride communicated by Peter Kien (*Zeits. f. wissensch. Photographie*, 1908, vol. vi., 337) there occurs a sentence to the following effect:—

"How difficult it is to decide upon the brilliancy and intensity of a spectrum by means of photography may be shown by the following example:—

"Prof. Hartley has published a very beautiful small photograph of the cupric chloride spectrum, the only one, moreover, which up to the present has been published. It is not in the least over-exposed, notwithstanding that Hartley gave it an exposure of two hours. My photographs were over-exposed in ten minutes—even if, as Hartley did, I brought cupric oxide into the oxygen and coal-gas flame saturated with chloroform vapour."

I think it is due to the author and others to point out that he writes under a misapprehension, inasmuch as his spectra and mine were taken each in a different manner and with a different object in view. He desired to photograph the best spectrum obtainable from the chloride for the purpose of measuring the bands, and therefore burnt the usual rolls ("cigarettes") of filter paper containing either cupric chloride or the oxide. The "cigarettes" were pushed by a spring through a tube into the flame at a speed regulated by a clock-work arrangement.

When communicating a paper on some devices facilitating the study of spectra (Sci. Proc. Roy. Dublin Soc., vol. xi., p. 237, 1907), I demonstrated the extreme delicacy of the cupric chloride reaction in explanation of the reason that, although there may be no green coloration of the flame by copper, nevertheless the blue flame and cupric chloride bands are seen when salt is thrown into a fire of glowing coals.

The experiment was made in the following manner:—a quartz fibre about a millimetre thick was placed in a solution of a copper salt and heated in the flame of the Meker (or Mecke) burner supplied with coal-gas, which was burnt with a blast of air at a pressure of about 700 mm. of mercury. The fibre was heated until all the copper salt had been decomposed, as shown by scarcely any evidence of a trace of copper being visible in the flame when looked at in a darkened room. On diverting about one-third of the coal-gas through the flask containing sponge soaked in chloroform, the hydrochloric acid produced by the combustion of its vapour yielded a large and brilliant blue flame due to the cupric chloride, which was steady and continuous for a long period. For the illustration of the text of the paper the first exposure of the copper oxide was limited to two hours, then, without removing the fibre from the flame, the chloroform tap was turned on, and a similar exposure made.

An excess of hydrochloric acid prevents the spectrum being visible at all, so that with the large volume of nitrogen in the air, and the consequent reduction of temperature arising from the hydrochloric acid in the coal-gas flame, the proportion of chloroform vapour must be limited, and the resulting quantity of cupric chloride vaporised is correspondingly small.

In the experiments made by Kien, the greater intensity of photographic action is caused by the use of oxygen under pressure along with coal-gas, whereby, in consequence of the much higher temperature and greater quantity of heat, he is able to feed the flame with a much larger proportion of chloroform vapour, and consequently to volatilise a very much larger quantity of cupric chloride in the same period of time than is possible with the air blast. Furthermore, by the use of the "cigarette," he has a larger quantity of copper in the flame at any given moment.

As a rule, my flame spectra are obtained by using the oxy-hydrogen blow-pipe, and when the hydrogen is mixed with chloroform the photographic period of exposure, according to circumstances, varies from thirty seconds to five minutes.

That salt is decomposed and hydrochloric acid formed by the action of water vapour when salt is thrown into a coal fire is certain. It is proved by the fact, which I found out when studying this spectrum in 1887, that the characteristic blue flame is not obtainable when salt is thrown into a fire of charcoal. In 1890 Salet proved the origin of the blue flame to be cupric chloride (*Comptes rendus*, cx., p. 282), and not in any way connected, as had been suggested, with the spectrum of carbon, carbon monoxide, or hydrocarbon flames, nor due to the element chlorine or to hydrochloric acid. My interest in the matter thus came temporarily to an abrupt termination, because, having by this time become aware that minute quantities of copper are to be found in most metalliferous and many other minerals, also in acids, it was easy to account for the blue flame being frequently seen by reason of the extraordinary delicacy of the cupric chloride flame reaction. Coal ashes always contain copper, the origin of which is commonly pyrites, and in the fire this is speedily burnt to oxide. Sulphur dioxide, steam, and air, even below a very dull red heat, convert salt into sodium sulphate and hydrochloric acid, and hence the formation of cupric chloride in presence of an excess of hydrochloric acid. Kien's paper gives an admirable historical account of the subject, which is particularly interesting owing to the extraordinarily illusive and elusive character of this spectrum. Much of this may be read in the *Phil. Mag.* (4), vol. xxiv., 417–9, and the pages of NATURE during 1876 and 1879.

A very beautiful engraving of the cupric chloride bands is given in Lecoq de Boisbaudran's "Spectres lumineux," published in 1874.

W. N. HARTLEY.

Royal College of Science, Dublin, February 11.

On the Radio-active Deposits from Actinium.

IN the course of some experiments which Mr. W. T. Kennedy has been making at Toronto during the past few months, he has found a marked similarity in the active deposits obtained on positively and negatively charged electrodes placed within an air-tight vessel and subjected to the influence of the active emanation issuing from a sample of actinium.

In his experiments the electrodes consisted of two small circular brass discs provided with guard rings of the same metal, and placed parallel to each other at a distance of 2 mm. apart. The discs during an exposure were placed with their planes vertical and directly over an open metal tube 1·5 mm. in diameter, with the edges of the guard rings almost in contact with the edges of the upper end of the tube. The salt used was carried in a small tray which could slide freely up and down the tube, and by means of a clamp be supported at any required distance from the discs.

In carrying out a set of experiments on the effect of varying the pressure of the air in the vessel containing the discs and the salt, it was found at high pressures that the active deposit appeared almost entirely on the negative electrode. As the pressure was decreased, however, the active deposits on both electrodes increased, and ultimately at certain definite pressures, which were different for the two electrodes, reached maximum values. When the pressures were still further lowered, the amounts of the deposit received on both electrodes rapidly decreased, and finally approached equality. Up to the present the lowest pressure used is ½ mm. of mercury, and at this pressure the deposit on the negative electrode was found to be only about 3 per cent. greater than that obtained on the positive. From the rapid character of the decrease in the amounts of the deposit obtained at the lower pressures, it seems highly probable that, with the arrangement of apparatus used, and the relative distances between the parts adopted, both electrodes would fail to show any activity, or at greatest a very small one, if the air were entirely removed from the exposing vessel.

In a particular experiment with the salt at a distance of 1 cm. from the disc electrodes, a maximum activity was

obtained on the negative electrode at a pressure of 6·5 cm. of mercury, while for the same distance between the salt and the electrodes the maximum deposit on the positive electrode was not obtained until a pressure of 1 cm. of mercury was reached. In this experiment the maximum activity obtained on the negative electrode was about 2·75 times the maximum activity obtained on the positive terminal. In all the experiments at the various pressures the discs were exposed for two hours to the action of the emanation from the actinium before being removed from the exposing vessel for measurement. The salt used was obtained from the Chinin Fabrik at Brunswick, Germany, and the active deposits on both the electrodes were found to have a decay period of approximately thirty-nine minutes.

The experiments as a whole point to the ions produced by the radiation from the active salt and its products in the gas in which the salt is placed as the carriers of the active deposit. They seem to indicate, moreover, that the known differences in the rates of diffusion of positive and negative gaseous ions will suffice to explain the differences obtained in the amounts of the active deposit on the two electrodes. J. C. McLENNAN.

Physical Laboratory, University of Toronto, February 6.

Germination of the Broad Bean Seed.

MR. HEBER SMITH's observations on the relation of the micropyle to the radicle in the seed of *Vicia faba* (NATURE, February 4, p. 400) are quite correct. It is surprising that the structure and germination of this seed, so extensively used in elementary botanical teaching, should be so frequently misunderstood by teachers and wrongly described in text-books. The curious minute structure of the coat of leguminous seeds has been thoroughly investigated by Haberlandt, Beck, Pammel, and others, but has never, to my knowledge, found mention in any student's text-book. There is, however, no excuse for the inaccurate statement, made in many an elementary work on botany and on nature-study, that the radicle always grows out through the micropyle when germination begins. Beyond admitting water into the seed, the micropyle, as a rule, merely forms a weak spot in the testa and enables the radicle to split the latter, while in leguminous seeds the splitting occurs quite independently of this aperture.

In the broad-bean seed, with its well-developed "radicle-pocket," the swelling radicle, aided by the elongating cotyledon-stalks, pushes out a V-shaped flap, the micropyle being (as Mr. Heber Smith states) left intact. The two "lines of weakness," which form the edge of the flap, answer to the junction of the radicle-pocket with the inner surface of the testa. The partition which constitutes the inner wall of the pocket can be seen in sections of young seeds as a ridge projecting into the seed cavity between the micropyle and the radicle.

In the seeds of French bean (*Phaseolus vulgaris*) and scarlet runners (*P. multiflorus*, &c.) the pocket is less highly developed, and at an early stage the coat splits transversely, starting from the tip of the radicle. As in the broad bean, the micropyle remains intact at the end of the hilum.

The early stages in the germination of broad bean are, I believe, accurately shown in my "Life-histories of Common Plants," Fig. 10. FRANK CAVERS.

Hartley University College, Southampton, February 13.

Scientific Societies and the Admission of Women Fellows.

NATURE of February 11 contains an able article on the Chemical Society and the admission of women fellows. Much of what is said in that article would apply equally well to the Geological Society.

On May 15, 1907, the council proposed a new bye-law for the admission of women as "associates." There is no authority in the charter for the admission of associates, whether women or men; and the proposition was rejected by a majority of two. The council having apparently dropped the subject, a special meeting was, on the requisition of certain fellows, held on April 1, 1908, when a resolution was proposed by Mr. E. A. Martin for the admission of women as fellows. This was defeated in favour of a motion by a member of the council that a poll be taken of all the fellows resident in the United Kingdom. The validity of such a poll having been questioned, the president (Prof. Sollas) admitted that there would be no validity in it, but said that, whatever the result might be, the council would loyally abide by it. The result of this poll was in favour of the admission of women as fellows. Subsequently, some non-resident fellows having objected to being excluded from voting, a further poll was taken of non-resident fellows, with a similar result. The votes recorded in the two polls were:—in favour of the admission of women, 439; against, 160. Of the 439, 318 were in favour of admitting women as fellows, 109 as "associates," while 12 expressed no preference. It is thus shown that there is a decided preference for the admission of women as fellows.

Notwithstanding these votes, and the statement that the council would abide by the result, the council has apparently done nothing to carry them into effect; but on February 10 a special meeting (convened by the council) was held to consider the result of the vote, but no intimation was given that any resolution would be proposed. The council put forward certain objections to the admission of women, and a motion by Dr. A. Smith Woodward, "That it is desirable, under the existing charter, to admit women to candidature for the fellowship of the society, on the same terms as men," was rejected by a majority of ten votes.

Whatever objections the council may have to the admission of women as fellows, it seems only reasonable that the fellows should have been informed before being called upon to express their wishes. By inviting them to vote, it was certainly implied that the decision of the fellows would be respected.

During the past twenty years there have been many able papers contributed by lady geologists, and the fellows have expressed a wish that women should now be admitted to the society on the same terms as men. By rejecting the wishes of the fellows, the council is acting, not only unjustly to lady geologists, but is ignoring the expression of opinion which the council itself invited.

Hythe, February 20. W. J. ATKINSON.

Stone Circles in Ireland.

IN his paper, "Who built the British Stone Circles?" read at the Dublin meeting of the British Association (NATURE, December 24, 1908, vol. lxxix., p. 236), Mr. J. Gray says he believes there are few, if any, such stone circles in Ireland. The accompanying photograph shows

Stone Circle, Culdaff, Co. Donegal.

one at Culdaff (river, bay, and village of the same name), on the north coast of County Donegal.

Only a few of the stones are now standing. Some have fallen down, others have been taken for building or other purposes; enough, however, still remain to show the form of the circle. Beyond it, on the eastern side, lie several blocks in two diverging rows. A short distance away there is a double-chambered structure of upright slabs, once covered by a mound, which, many years ago, was carted away and spread over the farm by a former tenant.

W. E. HART.

Kilderry, Londonderry, February 15.

ULTRA-MICROSCOPIC VISION.

IN NATURE, November 5, 1908, a short paragraph appeared in reference to a letter received from Mr. C. V. Raman, of the Science Association Laboratory, Calcutta, referring to a method of dark ground illumination for the microscope. From it, and from a subsequent communication on the same subject, it would appear that the subject of dark ground illumination and ultra-microscopic illumination may in certain directions give rise to controversy, and result in some confusion of thought.

It is unquestioned that any method of microscopic illumination in which the direct axial beam of light is cut out, and where, therefore, a grazing or oblique illumination is obtained, may result in making visible some particles that are beyond the limits of a microscope illuminated by ordinary methods.

It must at once be admitted that it is difficult to define the exact boundary beyond which objects may be said to be ultra-microscopic. To appreciate this point, it is necessary to refer very briefly—owing to the limits imposed in such a short article as this—to the wide difference between the limits of microscopic resolution and microscopic visibility.

To define the limits of resolution of the microscope is not difficult, as this is purely a function of the numerical aperture of the objective. The limits in this direction have been accurately determined, and practically agree in theory and practice. In the case of periodic structure, such as in diatoms, or in mechanically-ruled plates such as Grayson's rulings, this resolving limit can be found by multiplying the numerical aperture of the objective by 80,000 when monochromatic green light is used, and illumination is by a solid axial cone of light. This means approximately that lines of more than 120,000 to the inch would be beyond the limit of resolution when using an objective with N.A. 1·40, the largest aperture generally available at present; or that two points lying closer together than the distance between these would be evident, not as two separate images, but would so overlap as to appear as one.

This, however, is by no means the limit of visibility, and Lord Rayleigh states that isolated objects, or two bright areas separated by a dark line, may be seen if the dark line is as narrow as 1/16, and under certain conditions 1/32, of a wave-length of light, although the resulting image does not of necessity represent the actual appearance of the object. The flagellum of a bacterium, for instance, may be much beyond the limit of resolution, but is visible because it is an isolated object.

Another factor is the intensity of the incident light, and there is some reason to conclude that any relatively isolated object may be visible if it is illuminated with sufficient intensity, and can reflect light enough for the eye to appreciate. A keen observer will see in a microscopic image all structure that the best objectives can reproduce with a magnification of little more than 750 diameters, although it may be convenient to amplify the image beyond this to facilitate observation. Objects that are smaller than this limit of resolution are generally referred to as ultra-microscopic, although it is obvious that the term is not always justified. It is clear, therefore, that to define the meaning of the term "ultra-microscopic" is by no means simple, and especially in view of the fact that most methods of dark ground illumination do result in the formation of images that are not seen in other ways.

Illumination in the microscope by means of light projected at various angles to the optical axis has been common for very many years. The writer has used, for example, an oil immersion paraboloid made by Messrs. Swift and Son, probably very soon after the introduction of oil-immersion objectives, say about 1875, and the results to be obtained with it compare favourably with those of more recent introductions. At various times, other methods have been introduced. The simplest, and one of the earliest, was what is known as a "spot lens," also a dry paraboloid, and the arrangement by which the ordinary substage condenser may be utilised. In each of these a blackened stop of suitable size is placed beneath the optical portion of the illuminating system in such a position that the central axial rays are obstructed, and no light directly enters the objective. Only light refracted or reflected by the object reaches the objective, and the former, therefore, shows up brightly illuminated on a more or less dark background. With each of these arrangements only objectives of relatively low aperture can be used.

Other methods are those in which a stop is placed above the posterior combination of the objective, or the very ingenious arrangement suggested by Mr. J. W. Gordon, in which the stop, in this case a small globule of mercury, is placed above the eye-piece in the position occupied by the Ramsden disc. The closest approximation to the modern ultra-microscope of Siedentopf is the type of dark ground illumination in which the light is reflected so that it impinges upon the object at right angles to the optical axis of the microscope, but in none of these is any attempt made to confine the illuminating beam to the area under observation.

In 1903 an entirely new method of rendering visible ultra-microscopic particles was brought out by Siedentopf, and arose out of some investigations being made on various shades of ruby glass. As is probably well known, the colouring of ruby glass is dependent on small particles of gold, the dimensions of which approach in size to that of a molecule. If examined under an ordinary microscope and by ordinary methods of illumination, or by any method of dark ground illumination, even with the very best objectives there is no indication of the presence of any isolated particles. But, by a method of projecting a very thin cone of light at right angles to the optical axis of the microscope, and exactly on the spot under observation only, they were able clearly to observe diffraction discs which became visible, and arose from each individual particle of gold in the ruby glass.[1] The method is therefore one entirely depending on the arrangement and exact control of the illumination. The initial intensity of the illuminant must be high, so that only the electric arc or sunlight is suitable.

In general, the illumination of the object is accomplished by projecting the image of a very narrow precision slit, which is constructed in a similar manner to those used on fine spectroscopes so that both the length and breadth of the slit can be varied and exactly determined on to the object. The apparatus is arranged so that a very powerful beam of light is projected through the slit and focussed by a suitable optical arrangement so that the apex of the cone of rays falls exactly on the spot in the object where the objective is focussed, and so that no particles lying above or below this spot are illuminated. Consequently, only the particles in the field of view are sufficiently luminous to form an image in the microscope, and no particles lying outside this field can diffuse light and interfere with the formation of the image.

This latter disadvantage is common to all other methods of dark ground illumination, and it is in this respect chiefly, if not entirely, that the Siedentopf

[1] See Journal of the Royal Microscopical Society, 1903, p. 573.

method differs from all others. It would happen with a powerful source of light, unless the apparatus were thus arranged, that so many small particles would be illuminated that the diffraction discs would overlap and simply produce a general diffusion of light, and but very few individual particles, and of these only the more isolated ones, would therefore be visible. This is exactly what happens with any ordinary method of dark ground illumination where the particles are numerous or where they are distributed throughout a considerable area. In the Siedentopf method, where the light is simply concentrated on one spot in the field alone, little or no interference between the diffraction discs results, internal reflections between the components of the optical system are reduced to a minimum, and consequently an image is obtained which under other conditions would be impossible.

Considerable developments have taken place recently in methods of dark ground illumination. It is now possible to view such objects as bacteria with ease, without resorting to the excessive staining that is unfortunately so prevalent, enabling them also to be observed while in the living condition. The most satisfactory of these is the parabolic illuminator recently introduced by Messrs. Zeiss (Fig. 1). It may easily be said, and it is perfectly true, that the parabolic illuminator, either dry or oil immersion, is no novelty, but the one made by Messrs. Zeiss has been developed along scientific lines, and is the result of careful computation, whereas those made in the earlier days of microscopy were largely the result of chance, or at least trial and error, and it was a fortunate circumstance if they gave a result which was entirely satisfactory.

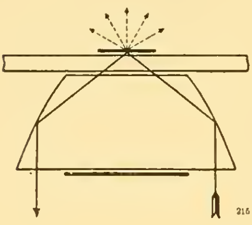


FIG. 1.

In the case of the Zeiss parabolic illuminator, the light is so reflected from the internal surface of the paraboloid that the annular cone of rays is projected, and has its focal point exactly where the objective is focussed. It would not, of course, give the same results as Siedentopf's method with such objects as ruby glass or colloidal solutions, but for observing minute living bacteria or similar transparent objects it leaves little to be desired. The illuminating rays, too, are exactly confined within the limits of a numerical aperture of 1·1 to 1·4, so that, if using, say, a 4-millimetre apochromatic objective with an aperture of 0·95, no rays would enter directly, and it would only be those reflected or refracted by the object that would pass into the objective at all, the objects, in fact, behaving as self-luminous bodies. This is a definite improvement on the method of introducing a stop into the substage condenser, so that the central rays are blocked out, and only the peripheral rays are allowed to pass, as there is much less spherical and chromatic aberration, the image being to a large extent dependent on reflected light. This appliance will render particles visible that might be termed ultramicroscopic, and in any solution or preparation of bacteria in water a great number of diffraction discs will be visible that by ordinary direct light could not be seen.

Another method that fulfils its purpose is the reflecting condenser made by Messrs. Leitz, of Wetzlar. In this, two reflecting surfaces, the one internal and the other external, as shown in Fig. 2, are so shaped as almost completely to unite the rays at a point P. The light enters from below, and takes the direction as shown by the dotted lines, ultimately converging on the point P, which is the position of the object, and is the focal point of the objective. It is obvious, therefore, that there is no chromatic or spherical aberration. The adjustments for centring are exactly the same as for an ordinary substage condenser, and the optical portion is contained in the mount that slides into the ordinary substage carrier. This apparatus, as well as the Zeiss, requires that the object-slide and the cover-glass shall be of a certain thickness, and cedarwood oil is used between the top surface of the condenser and the slide. It may be used as shown with any dry lens, but the best results are obtained with an apochromat, especially with the 4-millimetre 0·95 N.A. The cone of the illuminating rays is confined within the same limits as the Zeiss apparatus.

It is necessary to remember, however, that because a particle that is invisible by axial illumination becomes visible by oblique light, it does not, therefore, follow that it is ultra-microscopic. Its transparency may be too great, or its refractive index may too nearly coincide with the medium in which it lies for it to be visible by direct light. By oblique illumination a much smaller difference in refractive index between the object and its medium will be sufficient to form an image.

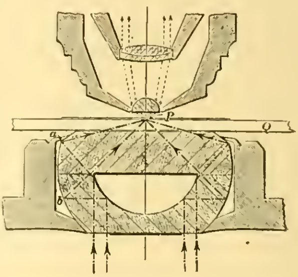


FIG. 2.

It is very difficult within the limits of a short article such as this to go into the matter sufficiently thoroughly to deal with all the points at issue. It may easily be urged that particles that are ultramicroscopic can be made visible by methods other than those described. It is well known that even passing a very powerful beam of light through a darkened room will render visible a large number of particles that cannot be seen by ordinary methods of illumination, and it is more than probable that many of the particles so observed are, in fact, ultra-microscopic. Faraday was able, by projecting a powerful beam of sunlight through a piece of ruby glass, to view the diffraction discs arising from the gold particles in the glass without any microscope at all. The whole question resolves itself really into the necessity of having primarily a sufficiently strong source of light, and so to arrange the incidence of the light that only those particles in the field of view are illuminated. In many arrangements that have been described for microscopic illumination, these two conditions have not been combined, and it is only recently that it has been thoroughly realised that either one without the other will not give the looked-for result.

J. E. BARNARD.

A PURE MILK SUPPLY.

THE importance of a supply of pure and wholesome milk can hardly be exaggerated, and during the last few years much has been done to ensure this by the education of the producer, and by the formulation of regulations by the health authorities. Contamination may take place at four stages:—(1) the cow may be unhealthy, *e.g.* tuberculous; (2) the condition of the farm and milkers and the methods employed may be unsatisfactory; (3) contamination may take place in transit; or (4) during or after sale to the consumer.

In dealing with some phases of this subject, a practical acquaintance with trade conditions is necessary, or impracticable regulations may be imposed. Thus, in a paper read by Mr. Primrose McConnell before the Royal Society of Arts,[1] reference was made to the exaggerated ideas of some sanitarians as to the cubic and floor spaces required in the byres, and, as the author remarked, if the ventilation is properly arranged for, the mere air-space in a shed is a subordinate matter.

The arm-chair sanitarian is apt to forget that one milking has to be done in the early hours of the morning—in winter in dark and cold—that disinfectants, clean smocks, and hot water may be unattainable luxuries, that in many cases all that can be hoped for is the promulgation of the doctrine of general cleanliness, and that to insist on liberal air-space and various structural conditions in the cow-sheds may mean an outlay which will render the production of the milk too costly to give an adequate return to the farmer. Far be it from the writer to suggest that ideal conditions should not be formulated and put into practice whenever possible, but in all cases the regulations should be drawn up with the help of trade experts, and with a due regard to the conditions of the district.

No doubt the conditions of supply which formerly obtained, and perhaps to some extent still exist, in some of the smaller farms are much to be deprecated, but a great deal has been done, particularly by the large dairy companies of the metropolis, to remedy this. The problem of transit is still one that requires much attention; the ordinary milk churn is a dirt and dust trap by which much contamination may be introduced into the milk, and refrigerator vans need to be provided by the railway companies. The ordinary method of serving milk with a dipper, and the manner in which milk in bowls is allowed to stand on the counter by the smaller vendors amid a heterogeneous collection of other goods, are in urgent need of alteration.

To some statements made by Mr. McConnell in the paper referred to the writer would take exception. Thus, the existence of large numbers of microbes in milk, provided none was definitely pathogenic, was considered to be of no importance. But large numbers of microbes generally indicate dirty production, which in its turn facilitates the entrance of harmful bacteria. Moreover, milk swarming with microbes may in some cases produce gastro-intestinal disturbance. Tuberculin was considered to be of no value, but veterinary authorities in all countries are unanimous in regarding it as of the greatest value in the detection of tuberculosis. The careful work of the commissioners of the Royal Commission on Tuberculosis on the transmission of bovine tuberculosis to man cannot be summarily dismissed by the statement that "their far-fetched experiments and tests have not proved it to the satisfaction of many people who understand the matter just as well as they do."

R. T. H.

[1] "London Milk Supply from a Farmer's Point of View" (Journ. Roy. Soc. of Arts, December 18, 1908, p. 83).

THE DENSITY OF GASES IN RELATION TO THE ATOMIC WEIGHT OF NITROGEN.

THE fourth and last instalment of the current volume of the well-known Geneva Society's Transactions, referred to below,[1] has a special interest for the chemist and physicist from the fact that it is wholly made up of a series of communications from the laboratory of chemical physics of the University of Geneva under the direction of Prof. Ph. A. Guye. The memoirs, five in number, deal with experimental researches on the physicochemical properties of certain gases in relation to the revision of the atomic weight of nitrogen, a problem which has occupied Prof. Guye and his collaborators for some years past. The greater number of the main results have already been seen in abstract in many serial publications. The work before us contains the full memoirs, which are illustrated by carefully executed drawings of the apparatus employed.

The respective titles are:—

I. "Détermination des Densités des Gaz anhydride carbonique, Ammoniac et Protoxide d'Azote par la Méthode du Volumètre." Ph. A. Guye et Al. Pintza.

Annexe I.: "Contrôle des Densités de l'Oxygène et de l'Anhydride sulfureux." A. Jaquerod et Al. Pintza.

Annexe II.: "Essai sur la Détermination du Poids atomique de l'Azote par l'Analyse en Volume du Gaz ammoniac." Ph. A. Guye et Al. Pintza.

II. "Détermination de la Densité de l'Oxyde Azotique par la Méthode des Ballons." Ph. A. Guye et Ch. Davila.

Annexe: "Densité du Gaz acide chlorhydrique." Ph. A. Guye et G. Ter Gazarian.

III. "Sur la Compressibilité de quelques Gaz à O au-dessous de l'Atmosphère." A. Jaquerod et O. Scheuer.

IV. "Détermination des Pressions et Températures critiques de quelques Gaz." E. Briner.

V. "Résumé général." Ph. A. Guye.

The main results may be thus stated:—

The weights of the normal litre, that is, the weights of a litre of the respective gases at 0°, under a pressure of 1 atmosphere at sea level, under the latitude of 45°, are as follows:—

	Grams
Carbon dioxide	1·9768
Ammonia	0·7708
Nitrous oxide	1·9777
Oxygen	1·4292
Sulphur dioxide	2·9266
Nitric oxide	1·3402
Hydrogen chloride	1·6398

For the values of compressibility and critical constants of these gases, as well as of those of certain methyl derivatives, we must refer to the original memoirs.

The bearing of the observations so far as they are applicable to the question of the atomic weight of nitrogen is discussed by Prof. Guye in an introductory communication. The result is to show that Stas's value of 14·04 is probably too high, as has been shown independently by Gray. The most probable value is 14·01, a number already adopted by the International Committee on Atomic Weights in its last report.

[1] "Mémoires de la Société de Physique et d'Histoire naturelle de Genève," vol. xxxv., Fascicule 4. December. (Genève: Georg et Cie., 1908.)

EDUCATION AND EMPLOYMENT.

WE are glad to see that attention is being again directed to problems of the relation between education and national welfare. In his address as president of the Association of Technical Institutions, last year, Sir Norman Lockyer referred to the deplorable national wastage that goes on after children leave the primary school, and pointed out that by permitting the half-time system the State is

a consenting party to a cause of mental and physical weakness. This, as he remarked, is not a question of party politics—it is simply a question as to whether the nation is content to see the standard of height and the standard of weight of many children being reduced in order that employment of half-timers should be continued. As to the school-leaving age and the need for further education in continuation schools, Sir Norman Lockyer urged that something should be done to show that the real interests of the employers lie in the fact that if the children can be taught how to learn for a little longer time, all those in their employ, at whatever age, will be more useful to them. It was suggested that the Government should be brought into operation in the same way—the same very definite and perhaps rather drastic way—as has been done in Germany. In Germany, as Prof. Sadler shows in the valuable work on "Continuation Schools" edited by him, employers of labour are obliged to grant to all their employees under eighteen years of age attending continuation schools arranged by the Government or the local authority, the necessary *time for school attendance as prescribed* by the authority in question. Attendances at continuation schools can be made compulsory for male persons under eighteen years of age by the bye-law of a district or town council. Only in five States, representing about one-forty-sixth of the population of the German Empire, is attendance at continuation schools wholly voluntary.

Dealing with the main causes of unemployment and various proposed remedies, the recently published report of the Poor Law Commission provides useful guidance as to a desirable direction for future educational enterprise. The development of continuation schools for boys who have left the elementary school and a modification of the prevailing type of curriculum in primary schools are urged. The report condemns emphatically the widespread evil of employing boys who have just left school in immediately remunerative but uneducative occupations which lead nowhere and provide them with no special knowledge to ensure their employment later in life. The Commissioners

> regard with favour the suggestions that boys should be kept at school until the age of fifteen instead of fourteen; that exemption below this age should be granted only for boys leaving to learn a skilled trade; and that there should be school supervision until sixteen, and replacing in school of boys not properly employed.

Experience has shown that a long time may elapse before the recommendations of a Royal Commission are translated into Acts of Parliament, but, in view of the powers given to Scottish school boards by the recent Education Act for Scotland, it may be hoped that it will not be long before something is done to give the English boy from the elementary school an education and training in his teens which will ensure his becoming a skilled worker when manhood is reached.

The Commissioners, we are glad to note, have not ignored the necessity for providing during the years of adolescence suitable technical instruction for the boys upon whose ability as skilled artisans our industrial efficiency as a nation will in the future depend. The report insists that

> There is urgent need of improved facilities for technical education after the present age for leaving school. With a view to the improvement of physique, a continuous system of physical drill should be instituted, which might be commenced during school life, and be continued afterwards; and, in order to discourage boys from entering uneducative occupations which offer no prospect of permanent employment, there should be established, in connection with the Labour Exchange, a special organisation for giving boys, parents, teachers, and school managers information and guidance as to suitable occupations for children leaving school.

We can imagine no more effective method of reducing in future years the ranks of the unemployed than that recommended in the report. The problem is first to educate the parents to forego the advantage of their boys' immediate earnings—providing them with some solatium, if necessary—and then to provide the boy with suitable employment which will enable him to learn a trade, and to be a skilled worker in his manhood. To convert him into a competent artificer it is necessary to see that the boy attends the technical school during his apprenticeship, or corresponding years, for a certain number of hours which form part of his working day.

But, as has been pointed out in these columns again and again, the full advantages of a scheme of technical instruction cannot be secured unless the boys attending the classes of the technical institute have received an adequate and suitable education in the elementary school during the years up to fifteen. In the past, the type of curriculum and the general character of the education have been unsuitable for boys who will later become manual workers. The Commissioners have recognised these facts, and they recommend the Board of Education earnestly to consider the necessity for re-modelling the practice and ideals of our elementary schools. To quote the report:—

> A considerable amount of evidence has been submitted to us to the effect that the present system of elementary education is not adapted to the wants of an industrial community. There is a consensus of feeling, in which we ourselves concur, that the present education is too literary and diffuse in its character, and should be more practical. It should be more combined than at present with manual training. It is not in the interests of the country to produce by our system of education a dislike of manual work and a taste for clerical and for intermittent work, when the vast majority of those so educated must maintain themselves by manual labour. If school training is to be an adaptation of the child to its future life and occupation, some revision of the present curriculum of public elementary schools seems necessary.

Men of science will welcome this full and generous recognition of the claims of "practical" subjects to take a large part in the education of children who will later constitute our industrial community—a necessity which was urged in the report of the British Science Guild Committee, published in NATURE of January 28 (p. 283). Manual work must be treated with respect, and every effort made to explode the prevalent fallacy that ill-paid and precarious clerical work is more "respectable" than honest, skilled constructive labour.

Since the publication of the report of the Commission an influential and representative deputation has waited upon the Prime Minister on the subject of boy labour, and many of the considerations here passed in review were urged upon the Government. In replying, Mr. Asquith dealt in an illuminating and sympathetic manner with the years between leaving school and reaching manhood—the unbridged gap, as he called it. After endorsing to a large extent the recommendations of the recent report, Mr. Asquith dealt with some of the education difficulties. He said:—

> I think the most interesting and suggestive part of the discussion to which we have listened this afternoon has been upon the subject of the exemption, the raising of the age of exemption, and of enlarging the use, perhaps by compulsion, of continuation schools. I am entirely with you, I think, in the most advanced views that have been

offered to-day upon both these matters; but being compelled by the exigencies of the life I lead to deal with these matters in a practical spirit—in other words, to calculate the length, the breadth, and the weight of the obstacles which have to be encountered—the remedy is not quite so easy to discover and to apply as to the more sanguine among us it may, at first sight, appear. For instance, there is this question of raising the age of exemption. There you are confronted with these discouraging figures from the Lancashire operatives, where, upon a poll on the question of raising the half-time age to thirteen, barely 34,000 voted in the affirmative and no less than 150,000 voted in the negative. I agree that a few years ago the figures would have been much more discouraging than they are now. But one hopes that with the advance of information and the efforts of the enlightened leaders like my friend Mr. Shackleton there may be a considerable movement in a better direction. But it is obvious that at the moment it would be extremely difficult to apply by any statutory form of compulsion a measure which, so far as regards the great bulk of the operatives are concerned, a large majority are not prepared voluntarily and spontaneously to accept. That is a case for what is called spade-work, which I hope may produce its results before long. When we come to the question of continuation schools, I think the prospect is more satisfactory and hopeful. We did something for Scottish education in the Scottish Act last year, and I hope it is not too sanguine a view to take if one expresses the hope that England will soon level itself up to the standard of Scotland in that matter. Again there is a difficulty. As one of the speakers pointed out, if the boys or the girls are kept hard at work in a monotonous way at unintellectual occupations during a great many hours of the day, you cannot expect them to bring to the continuation school, or evening school, anything like a fresh intelligence or that power of receptivity which is essential to the efficient working of such institutions. There comes in that question of the half-timer again. I cannot help thinking that if employers of labour would more generally take the course which Sir Albert Spicer has taken, and which Mr. Cadbury has taken, of making it a condition when they employ these young boys and girls in their works that they should spend one or two evenings in a continuation school, their regular hours of labour being so adjusted that it is not an excessive strain either upon their intellectual or physical capacity, we should find, if not a solution, the way of going very near to the solution of that part of the problem.

A report upon the problem of education in relation to apprenticeship, especially as it concerns the children of London, is to be presented by the Higher Education Sub-committee of the London County Council Education Committee at a meeting to be held as we go to press. In this report the committee urges that, inasmuch as industrial training is a national and not a local question, technical institutions and technical scholarships should be supported to a much larger extent than at present out of funds provided by the National Exchequer.

As remedies for what are pronounced defects in our educational methods, leading to waste of effort and the sacrifice of future prospects to immediate needs, the committee makes a number of proposals which are identical in principle with suggestions for an organised educational system contained in the report of the British Science Guild Education Committee already published in these columns. The proposals put forward by the London County Council Committee may be summarised as follows:—

(1) The age of compulsory attendance at elementary schools should be raised to fifteen.

(2) Certain children should be transferred at the age of thirteen to trade or craft schools.

(3) The elementary-school curriculum should be made more practical by a considerable increase in the time devoted to various kinds of manual training.

(4) Local education authorities should be empowered to compel employers to allow their apprentices and learners the necessary time during the day to attend classes, and to enforce such attendance on the apprentices and learners.

(5) At least half the working day should be spent in school.

(6) All boys and girls not on the rolls of trade or secondary schools should be required to pass through a three years' course of "half-time" instruction at continuation schools.

It is to be hoped that statesmen will not wait until a mandate is received from those who benefit by child-labour before attempting to make our educational demands comparable with those of Scotland and Germany. Their duty is to safeguard the mental and physical welfare of the coming generation if our nation is to be kept in the van of progress. The continuation of the present system involves grave injustice to a not inconsiderable part of the child population of England, for the mental, moral, and physical training received during school life is soon lost after a boy drifts into one of the occupations of unskilled trades. As to further education, whether in day or evening continuation schools, or in secondary schools, there is much to be done before we can approach the conditions existing in Germany. While Germany is fast extending the age of compulsory attendance through the critical years of youth, in England and Wales not more than one in three of the children who leave the public elementary schools at thirteen or fourteen years of age receives any further systematic care as regards education of any kind. When our statesmen realise what a study in contrasts is afforded by the German and English systems of education, and what an inferior position we occupy, judged by any standard of educational measurement, they will perhaps do something to prevent the waste of body and mind which is a source of individual poverty and of national weakness.

SIR GEORGE KING, K.C.I.E., F.R.S.

SIR GEORGE KING, K.C.I.E., F.R.S., whose death at San Remo was announced in NATURE of February 18, was born at Peterhead on April 12, 1840. He was educated at the Grammar School and the University, Aberdeen, graduating in medicine in 1865. In the same year he entered the Indian Medical Service, and was posted to the Bengal Presidency.

Soon after reaching India, King was detailed for military medical duty in Central India and Rajputana, where his leisure was devoted to work of high quality as a field naturalist. From military duty he was transferred to act temporarily as superintendent of the Botanic Gardens at Saharanpur, in Upper India; shortly thereafter he was induced to join the Indian Forest Service, and was placed in charge of the Kumaon forests. While so employed he was selected by the Secretary of State for India as successor to Dr. Thomas Anderson, whose death in October, 1870, had left vacant the superintendentship of the Royal Botanic Gardens at Calcutta and of Cinchona Cultivation in Bengal.

When, in 1871, King assumed charge of the Calcutta gardens these were in the ruined condition to which they had been reduced by severe cyclones in 1864 and again in 1867. They had practically to be renovated, and the charm and beauty for which they are famed constitute an adequate memorial to King's energy, patience, and skill as a landscape gardener. The prolonged task involved considerable expenditure, and the readiness with which the necessary funds were supplied bears witness to the traditional enlightenment of the Government of Bengal and to

the confidence which King's organising powers inspired.

The cinchona department was just passing beyond the experimental stage when King was given control. Natural causes render the cultivation of cinchona in northern India unprofitable to private enterprise. Notwithstanding this fact, King so administered the Government plantations and factory that the Government was able, without incurring pecuniary loss, to place the remedies against malaria which cinchona bark yields within the reach of the poorest peasant in India.

The extent and gravity of King's administrative duties did not prevent him from prosecuting the botanical studies which made him one of the leading systematic botanists of the last quarter of the nineteenth century; but with rare self-denial he forbore the publication of his results until the tasks of restoring the gardens and organising the plantations and factory under his charge had progressed so far as to justify his giving the time that was needed to the preparation of ordered statements. But the fact that his scientific attainments were on a level with his administrative powers could not remain concealed from those with whom he corresponded on botanical subjects, and in 1884 he was promoted to the degree of LL.D. by his own university, while in 1887 he was elected into the Royal Society.

In the last-mentioned year the enlightened policy of the Government of Bengal enabled King to found the "Annals" of the Calcutta gardens, a series of sumptuous volumes in which he proceeded to enrich systematic study by providing monographs of difficult and important genera like Ficus, Quercus, Castanopsis, Artocarpus, Myristica, and families like Magnoliaceæ, Anonaceæ, and Orchidaceæ. These contributions to natural knowledge are characterised by the accuracy, lucidity, and completeness which marked everything he did. But as regards the branch of botany of which he thus became so distinguished an exponent, King was influenced by the sense of duty that had so long delayed the publication of his results. His personal predilections were towards problems other than systematic, and, as might be expected in one who had been a favourite pupil of the late Prof. Dickie, F.R.S., these were problems associated with cryptogamic studies. But King's practical mind realised that, important and enticing as such studies are, the path of duty for him led elsewhere. The greatest immediate service he could render to the official and commercial interests of India lay in the provision of recognisable descriptions of hitherto unknown or imperfectly understood phanerogamic plants of economic importance, and especially, as his experience as a forest official had taught him, recognisable descriptions of trees, too frequently neglected by workers whose study of herbaceous plants and shrubs may leave nothing to be desired. To this task King devoted himself in the most single-minded fashion, and in furthering it he commenced in 1889 the publication of the results of a sustained floristic study of the vegetation of the Malayan peninsula, issued from time to time in fascicles that were professedly intended to serve as precursors to a flora of that region, but are so admirably executed that they serve as an efficient substitute for such a work. In 1891, when the various botanical officers in India were linked together in one department, King became the first director of the Botanical Survey of India.

During his Indian career King was able to render much additional service to the country and its Government. He was long a trusted member of the Senate, and served for a term on the syndicate of the University of Calcutta. He was a member of the board of visitors of the Bengal Engineering College, an institution in which he took a warm and effective interest. He was an original member of the committee of management of the Zoological Gardens at Calcutta, the site of which he found occupied by a collection of hovels, and converted into a singularly attractive place of public resort. He was for many years a trustee of the Indian Museum, and for a time was chairman of the trust. He was president of the central committee appointed by Government to investigate the indigenous drugs of India, from its inception in 1894 until his retirement in 1898 after thirty-three years of devoted service to the people and the Government of India.

After his retirement King gave all his energies to the continuation of his "Materials for a Flora of the Malayan Peninsula." But his health, severely tried by his long residence in the East, became gradually more and more impaired, and he realised that he might never see the completion of the work he had allotted himself. His friend Mr. H. N. Ridley, F.R.S., director of the Botanic Gardens, Singapore, stepped into the breach and undertook the elaboration of the monocotyledonous families while King was engaged on the remainder of the dicotyledonous ones, and after 1902, when the thirteenth fasciculus, completing the Calycifloræ, was issued, another friend, Mr. J. S. Gamble, F.R.S., became associated with him in working out the Corollifloræ. Increasing infirmity gradually led to King taking less and less of an active share in the work, and the later families have been elaborated by Mr. Gamble alone.

King's skill as a landscape gardener led to the award of its Victoria medal by the Royal Horticultural Society. His services to humanity in connection with the manufacture and distribution of the alkaloids of cinchona bark were recognised by honorary membership of the Pharmaceutical Society, by the grade of "Officier d'Instruction publique," and by the gift of a ring of honour by H.I.M. Alexander III. of Russia. His invaluable contributions to natural knowledge brought him honorary association with a number of learned societies, and the award of medals by the University of Upsala and the Linnean Society of London, while his administrative qualities were recognised, on the eve of his retirement, by the Government of India.

King was keenly interested in art, in literature, and in many branches of science other than that in the promotion of which he took so active a part. With wide and accurate knowledge he combined a kindly sense of humour and a magnetic charm of manner which rendered intercourse with him a privilege never to be forgotten, and to his many friends his death leaves a blank that cannot be filled.

NOTES.

AT the meeting of the Royal Society on Thursday, February 18, telegrams of congratulation on the hundredth anniversary of the birth of Charles Darwin were read from the University of Christiania, the University, Kharkoff, the Naturalists' Students' Association, Kharkoff, the Society of Naturalists, Kharkoff, the council of lecturers, Moscow Women's University, and the Swedish Academy of Sciences, Stockholm. The president reported that telegraphic acknowledgments and thanks had been transmitted to the senders on behalf of the Royal Society.

M. H. POINCARÉ has been elected president of the French Bureau des Longitudes; M. Bigourdan becomes vice-president, and M. Deslandres secretary.

PROF. W. M. DAVIS was elected president of the Association of American Geographers at the recent annual meeting held in affiliation with the American Association for the Advancement of Science.

THE death is announced of Prof. Victor Egger, professor of philosophy and psychology at the Sorbonne, and distinguished chiefly by his work in psychology. We also notice with regret the announcement of the death of Prof. Carroll D. Wright, professor of statistics and social economics at Clark University, Worcester, Mass., and distinguished among American statisticians and economists.

WE notice with regret the announcement that Dr. D. J. Hamilton, formerly professor of pathology at Aberdeen University, died on February 19 at sixty years of age. Prof. Hamilton was for several years demonstrator of pathology at Edinburgh University, and was appointed in 1882 to the chair of pathology at Aberdeen University, which he resigned last year owing to ill-health.

A CORRESPONDENT writes asking for information concerning "arboreal tumours" which are to be observed attacking trees in certain damp, low-lying districts, and eventually leading to the destruction of the trees. A reference to Kew enables us to state that the subject is dealt with in the late Prof. H. Marshall Ward's "Diseases of Plants," published in the Nature Series of Messrs. Macmillan and Co., Ltd. The matter is lucidly discussed in chapter xxiv. of this work at pp. 222 *et seq.*

WE learn from the *Times* that a fresh attempt is being made to introduce the salmon into New Zealand. Similar attempts have been made previously on more than one occasion, but without success, which is the more remarkable as the acclimatisation of the trout was effected many years ago with the most satisfactory results, many of the New Zealand rivers being now well stocked, and the fish growing to a very large size. The difficulty seems to consist, not so much in getting the eggs to New Zealand in a healthy condition, as in preserving the young fish after hatching. About a million ova have lately been dispatched from London under the direction of Mr. Luke Ayson, the Chief Inspector of Fisheries of New Zealand, and it is hoped that success will attend the new venture.

THE anniversary meeting of the Geological Society of London was held on Friday, February 19, when the officers for the ensuing year were elected as follows:—*President*, Prof. W. J. Sollas, F.R.S.; *vice-presidents*, Mr. G. W. Lamplugh, F.R.S., Mr. H. W. Monckton, Dr. J. J. H. Teall, F.R.S., and Prof. W. W. Watts, F.R.S.; *secretaries*, Prof. E. J. Garwood and Dr. A. Smith Woodward, F.R.S.; *foreign secretary*, Sir Archibald Geikie, K.C.B., Pres.R.S.; *treasurer*, Dr. Aubrey Strahan, F.R.S. The medals and funds awarded, as announced in NATURE of January 21 (p. 347), were then presented. The president delivered his anniversary address, which dealt with time, considered in its relation to geological events, and to the development of the organic world.

BY the will of the late Dr. Francis Elgar, F.R.S., the sum of 1600*l.* is left to the Institution of Naval Architects for the endowment of a scholarship to be awarded as the council may decide, but the hope is expressed that the scholarship will be similar to that given by him during his life. After making other bequests, one-half of the residue (which will apparently amount to between 32,000*l.* and 34,000*l.*) is eventually to be divided equally between the Institution of Naval Architects for the encouragement of the science and art of naval architecture, and the University of Glasgow, to be held upon trust for the furtherance of the objects of the John Elder chair of naval architecture in that University.

AT the annual general meeting of the Physical Society on January 12 the following officers and council were elected for the ensuing year:—*President*, Dr. C. Chree, F.R.S.; *vic-presidents*, those who have filled the office of president, together with Mr. W. Duddell, F.R.S., Prof. A. Schuster, F.R.S., Mr. S. Skinner, and Dr. W. Watson, F.R.S.; *secretaries*, Mr. W. R. Cooper and Dr. S. W. J. Smith; *foreign secretary*, Prof. S. P. Thompson, F.R.S.; *treasurer*, Prof. H. L. Callendar, F.R.S.; *librarian*, Dr. W. Watson, F.R.S.; *other members of council*, Mr. A. Campbell, Dr. W. H. Eccles, Dr. A. Griffiths, Dr. J. A. Harker, Prof. C. H. Lees, F.R.S., Mr. T. Mather, F.R.S., Dr. A. Russell, Prof. E. Rutherford, F.R.S., Mr. F. E. Smith, and Mr. R. S. Whipple.

THE Washington correspondent of the *Times* announces that the State Department is preparing invitations, which will be sent out as soon as possible, for an international world conference at The Hague next September to consider the conservation of natural resources. In making this announcement, President Roosevelt said that, even though no great and important immediate results were derived from the conference in the direction of conservation, he hoped that all nations would be represented. The first immediate result of the conference is expected to be a general inventory of the natural resources of the world. An effort will be made to ascertain how the world stands regarding such resources, with discussion on what has been done by different nations towards conservation, what is best to do, and what may be reasonably expected.

MATERIAL for a series of illustrated lectures on the results which have been obtained by recent discoveries in the prevention or treatment of disease has been prepared by the Research Defence Society. A number of lantern-slides illustrative of progress and discovery in respect of malaria, yellow fever, sleeping sickness, Malta fever, diphtheria, &c., have been made, and the slides are accompanied by full descriptive catalogues, with notes and references, and a print of each slide, for the use of lecturers. The society is willing to lend these materials for lectures to accredited persons who are in sympathy with the excellent object of disseminating sound and trustworthy information on the aims and achievements of research in medicine and physiology. In certain cases the society is prepared to send a lecturer, and at all times will lend every assistance to ensure the success of a lecture to a good audience. Communications and inquiries on this subject should be addressed to Mr. Stephen Paget, hon. sec., 70 Harley Street, W.

AN interesting gathering of the Leeds Naturalists' Club was held on February 15 to celebrate the Darwin centenary. Mr. Harold Wager, F.R.S., delivered an address on Charles Darwin, in which he reviewed the life of the great naturalist, the unselfishness of both Darwin and Wallace in respect of their simultaneous discovery, the development of the hypotheses by Darwin himself and by Haeckel, Weismann, and Mendel. There was an interesting exhibit by the president of the club (Mr. W. Denison Roebuck) in the form of a lithographic facsimile of the illuminated address which a deputation, representing the naturalists of Yorkshire, headed by the late Prof. W. C. Williamson, F.R.S., presented to Darwin in November, 1880, in celebration of the coming of age of the "Origin of Species," and the autograph letter in which Darwin

acknowledged the compliment. Subsequently a resolution was adopted congratulating Dr. Alfred Russel Wallace, O.M., on the completion last year of fifty years from the simultaneous publication by the Linnean Society of the papers by Darwin and himself, in which the influence of variation and natural selection in the development of species was described.

IN NATURE of January 28 reference was made to the earthquake which was recorded by seismographs in India, Europe, and South Africa on January 23. Its origin was provisionally placed in western central Asia, but now proves to have been further south, in the Luristan district of Persia, about two days' journey from Burujird, where fifty villages are said to have suffered and 5000 lives to have been lost. This earthquake illustrates the difficulty which sometimes arises in fixing an origin from distant records; the European and Indian records gave a locus in the form of a band running about north-north-eastwards through the country east of the Caspian Sea, but did not permit of fixing it more closely. The Cape of Good Hope record should have supplied the data for doing this, as the observatory lies almost on the continuation of this locus, but that the earthquake, being no greater than that of Messina, the first tremors failed to impress themselves on the seismograph; this loss of the commencement of the disturbance made it impossible to determine the exact situation of the origin, and suggested that it was not, as has actually proved to be the case, at the nearest end of the strip of country indicated by the Indian and European records.

THE *Nineteenth Century* for February contains a paper by Dr. C. Davison on the Messina earthquake, illustrated by two sketch-maps, one showing the principal isoseismal lines of the earthquake, the other the seismic zones of southern Calabria, as delineated by Dr. M. Baratta. The places that were partly or entirely destroyed lie within three nearly circular curves, the most important including Messina, Reggio, and Pellaro, and having its centre beneath the Straits of Messina, the others in the neighbourhoods of Palmi and Monteleone respectively. The total area of these curves is estimated at about 500 square miles, and the disturbed area, including the portion covered by the sea, at about 150,000 square miles. The recent earthquake, like those of 1783 and 1905, was thus polycentric. In 1905, as in 1908, the different centres (namely, those near Palmi, Monteleone, Nicastro, Cosenza, and Bisignano) were in action simultaneously, or nearly so. In 1783 they came into action successively, the first great shock taking place in the Palmi zone, the second in that of Scylla, the third in the Monteleone zone, the fourth, as recently, in the Messina zone, the fifth in the Monteleone zone, and the sixth in the Girifalco zone. In other earthquakes single centres appear to have been in action, the Palmi zone in 1894, the Monteleone zone in 1659, the Nicastro zone in 1638, the Cosenza zone in 1854, and the Bisignano zone in 1836. Thus there appear to be several more or less detached centres of maximum disturbance, though their simultaneous activity in 1905 and 1908 indicates that there must be some deep-seated connection between them.

SEVERAL reports of scientific interest were referred to in the report of the council of the Institution of Mechanical Engineers, presented at the annual general meeting on Friday, February 19. Since October, 1907, an investigation for the Alloys Research Committee has been in progress in the metallurgical department of the National Physical Laboratory on the ternary alloys of copper-aluminium, and a report dealing with copper-aluminium-manganese is expected shortly. The results of the prolonged sea-water corrosion tests, which have been carried on at Portsmouth Dockyard on the specimens of copper-aluminium alloys, referred to in the eighth report, will be published with the next report of the committee. The research in connection with gas-tightness and steam-tightness of metal castings is being continued at the University of Manchester. The three new subjects selected for investigation in accordance with the vote of the members, referred to in the last annual report, have received attention during the year. A comprehensive report upon the transfer of heat across metallic surfaces in contact with water and with gases will shortly be brought before the institution for reading and discussion. Reports are also being prepared upon the features of refrigerating machinery in which further investigation is needed, and the action of steam passing through nozzles and steam turbines.

WE have received a newspaper cutting containing the report of the Port Elizabeth Museum for 1908, from which we learn that great efforts are being made by the president to develop that institution, especially from the point of view of local education. These endeavours are, however, considerably hampered by lack of sufficient financial resources. Several important additions were made to the collections during the year. The number of visitors who passed the turnstiles was considerably less than in 1907.

IN the February number of *Naturen* Dr. L. Stejneger adduces further evidence in favour of the theory of the existence, at a comparatively recent date, of a land-bridge between Scotland and Scandinavia. This evidence is mainly based on the distribution of the species, or races, of charr (Salvelinus), which is illustrated by a map. *Salvelinus alpinus* is considered to be common to western Scandinavia and Scotland, while in eastern Scandinavia we have the typical *S. salvelinus* of the Alps. Iceland is the home of *S. nivalis*, while further north occur *S. insularis* and *S. stagnalis*. Lapland is the home of an intermediate form known as *S. salvelino-stagnalis*, while another annectant type, *S. alpino-stagnalis*, occurs in Greenland.

HAVING completed the investigation of the degenerate eyes of the Australian marsupial mole (Notoryctes), Miss G. Sweet has directed her attention to those of the African golden moles (Chrysochloris), the results of this later study being published in vol. liii., part ii., of the *Quarterly Journal of Microscopical Science*. In the Chrysochloridæ the eye has sunk only into the dermis, where it is surrounded by the hair-roots; but the eye-muscles have disappeared, as has the vitreous humour, while the lens and iris are very degenerate. The optic nerve is retained in some instances and lost in others. Despite its comparatively superficial position, the eye is not visible externally; the loss of the eye-muscles is an unusual feature. That the eye, even were the cleft at the proper angle for admitting light-rays, is quite useless for vision is certain, and it is improbable that it is capable of detecting even degrees of lignt.

GREAT interest attaches to a paper by Mr. G. R. Wieland in the February number of the *American Journal of Science* on the structure of the Cretaceous marine turtles of the Protostegidæ, since the facts therein adduced go a long way, at any rate in the author's opinion, to solve the problem of the relationship of the leathery turtle (Dermochelys) to ordinary turtles (Chelone). These turtles, as represented by Protostega and Archelon, attained gigantic dimensions, and, in accordance with the needs of a pelagic

existence, lightened the carapace by a great reduction in the size of the costal plates, which are more aborted in the type-genus than in the modern Chelone, thus leaving very large intercostal vacuities. The reduction is carried to a still greater degree in Archelon, the absorption process being also extended to the neural bones, many of which, so far as can be seen, appear to be reduced to thin films. Upon the neurals in this genus are, however, superimposed a series of digitate epineural dermal bones, which correspond to the neural keel of Dermochelys, and discharge the function of the aborted neurals. It is added that in life Archelon must have possessed a leathery hide, with a system of keels similar to those of the leathery turtle. In conclusion, the author observes "that of the two camps which have attacked the difficult and highly attractive problem of the origin of Dermochelys, those favouring the view of a close relationship to ordinary turtles and a comparatively recent origin have rather the best of the argument." It seems, in fact, that Dermochelys and its allies, having become less pelagic in habits than ordinary turtles, found the reduction in the bony framework of their carapace a disadvantage, and they accordingly developed a secondary structure of overlying dermal bones to take the place of the proper carapace, which then underwent a still further reduction, and finally vanished.

The January number of the *Psychological Review* (Baltimore) contains a further contribution to the study of galvanometric deflections which they ascribe to psychological processes in man. This branch of work, which was started by Dr. Petersen, has led the authors to the conclusion that active emotional processes in man bring about electromotive forces, and consequent galvanometric deflections. These results have been the subject of somewhat sensational articles in the lay Press, but it is wise at present to withhold judgment on their interpretation. Voluntary muscular movements, secretion of the glands in the skin and other parts, the cardiac activity, and the action of other internal organs are all accompanied with electrical changes, and although the authors claim to have eliminated currents due to these causes, we do not think that physiologists accustomed to the study of electrophysiology by the use of the galvanometer or electrometer will be convinced that such is the case. The very erratic galvanometric movements described are just what we would anticipate in the bewildering intermixture of physiological activities which the intact human body presents. To conclude that they are produced in the anatomical correlate of various psychical phenomena is, to say the least of it, extremely premature.

Following upon a study of the genus Pentstemon in the Western States, Dr. L. Krautter has compiled a list, with diagnoses, of American species, that is published as vol. iii., No. 2, of the Contributions from the Botanical Laboratory of the University of Pennsylvania. The arrangement of the sections as drawn up by Asa Gray has been followed, but whereas Gray's last contribution recognised eighty species, the present collation includes nearly a hundred and fifty species.

While afforestation is providing a topic of general discussion, it is opportune to refer to the Chopwell Woods, an area of 930 acres near Newcastle, that was made over by the Commissioners of Woods in 1904 to Armstrong College. The working plan, by Mr. J. F. Annand, is briefly noted in the Transactions of the Royal Scottish Arboricultural Society (vol. xxii., part i.). The soil varies from stiff clay through loams to sand and pebbly gravels; the old plantations, chiefly of oak, larch, or Scots pine, are none of them productive. It is proposed now to grow various coniferous trees. Larch will be planted on the best-drained loamy soil, Scots pine on the poorest, and spruce will be tried on moist soil. Corsican pine, Sitka spruce, and Douglas fir will also receive a trial.

A book on trees and shrubs, native or introduced, to be published in sixteen parts, at the price of one shilling the part, is announced by Messrs. J. M. Dent and Co. The main object of the book is to provide descriptions for identifications of the plants, while short details regarding cultivation and origin have been given. Beginning with the Ranunculaceæ, the genera Clematis, Magnolia, and Calycanthus are treated in the first part. The authors, Messrs. C. S. Cooper and W. P. Westell, have perforce limited the species of Clematis to three, but ten of the Magnolias are described. The general plan is well conceived, and the text bears evidence of careful compilation, but a striking omission occurs in the absence of the names of the authorities for the specific binomials. The black-and-white artistic drawings by Mr. C. F. Newall are chiefly intended for diagnostic purposes, and sixteen coloured illustrations will serve to delineate general habit.

Colonel Pease, Inspector-General of the Indian Civil Veterinary Department, in the October (1908) number of the *Agricultural Journal of India*, records a discovery of much importance to poultry fanciers in the East. No more fatal disease than that hitherto known as "fowl cholera" is found in India. Quite accidentally, Conductor Dare at Mian Mir, while studying the surra disease in camels, ascertained by the use of the microscope that the death of some ducks from "cholera" was really due to a specific organism of the Spirochætes type. It is spread by the agency of the *Argas persicus*, or common fowl-tick, which it is difficult to destroy. The best method of dealing with it is to burn the old roosts and nests; but scraping the walls of the fowl-houses, painting them with hot coal tar, and brushing the feathers of the birds with paraffin have been found efficacious. Now that the disease has been traced to this parasite, a suitable form of treatment will doubtless soon be discovered.

The Weather Bureau of the Philippine Islands has issued an advance chart showing the approximate tracks of four typhoons that crossed the archipelago from September 23 to October 13, 1908. The first and fourth of these were remarkable for the terrific violence of the winds; the latter, also, for the great floods which swept the Cagayan Valley during the passage of the cyclonic centre. These typhoons will be discussed, in due course, in the bulletins for the respective months; the last number received is for February, 1908, and contains a catalogue of Philippine earthquakes for February, 1890–1907. The Manila Observatory, like those of Hong Kong and Zikawei, has published a typhoon-warning code; it is intended principally to lighten the burden generously borne by several telegraphic companies by the free transmission of reports between the chief meteorological services in the Far East.

To the Proceedings of the Rhodesia Scientific Association, vol. vii., part ii., Messrs. F. White and E. C. Chubb contribute a paper on a cave containing fossilised bones, worked pieces of bone, stone-implements, and quartzite pebbles. The cave is situated in a small hill of zinc and lead ores in north-western Rhodesia, and an account of its contents was given in the *Geological Magazine* for October, 1907. With the exception of a humerus and tibia of a rhinoceros, all the mammalian bones specifically identified are referred to existing forms. The rhinoceros-

bones are, however, considered to indicate an animal of slighter build than either of the living species, and are therefore regarded as belonging to an extinct form, for which the name *Diceros whitei* is suggested.

The Austrian Meteorological Office has issued, as part ii. of the "Climatology of Austria," a discussion of the observations at Trieste for the sixty years 1841–1900, by Mr. E. Mazelle, director of the maritime observatory at that place. In addition to its importance as a contribution to climatology, the discussion of this long series is intended to serve as a basis for the "reduction" of mean values in neighbouring localities for shorter periods to one of similar length. The tables contain, *inter alia*, mean and extreme values for yearly, five-yearly, and ten-yearly periods. The mean annual temperature of Trieste for the sixty years was 57°·4; July, 75°·6; January, 40°·1. The absolute maximum for thirty-two years (1869–1900) was 99°·5 (July, 1873); the minimum, 14°·0 (February, 1870); but in January, 1907, a reading of 9°·0 was recorded. The annual rainfall is approximately 43 inches; the wettest month is October, and the driest February; rain falls on an average on 109 days in the year.

The past week was exceptionally fine and dry over the whole of Great Britain, and the weather was practically rainless in all parts of England. The aggregate measurement of rain for February is likely to prove very much below the average over the entire area of the British Isles. At Greenwich the rainfall to February 24 was 0·32 inch. In February, 1891, the total measurement of rain at Greenwich was 0·04 inch, so that the present month is far from establishing a record in this respect. The duration of bright sunshine was everywhere large, and in England the weather was exceptionally brilliant. For the five days from February 18–22 inclusive, the sun shone for forty-two hours at Greenwich, where the average duration for the month is fifty-seven hours. Sharp frosts have occurred at night over England. At Greenwich the exposed thermometer on the grass fell below 20° on each night during the last week, and on three nights it fell to 11°. Frost also occurred each night in the shade, and on the morning of Tuesday, February 23, the thermometer in the screen fell to 19°, which is lower than any reading so late in February during the last sixty years. The day temperatures have been fairly high for the time of year, due to the bright weather, and on the four consecutive days from February 19–22 the thermometer in the sun's rays exceeded 90°, and on Monday, February 22, it rose to 97°. The fine and dry spell of weather over England was due to the prevalence of anticyclonic conditions, a region of high barometer readings being situated over the United Kingdom.

Natural science and the healing art formed the subject of Prof. Tschirch's rectorial address at the anniversary festival in the University of Bern in November last ("Naturforschung und Heilkunde," by Prof. A. Tschirch. Pp. 30. Leipzig: C. H. Tauchnitz, 1909. Price 1 mark). This ancient seat of learning can boast many great names in the past, and the new rector was able to point to Haller, among others, who recognised the importance of natural science in the progress of medicine. Growth in the knowledge of science has been accompanied by an increase in the means the physician and surgeon possess in grappling with disease. Chemistry is no longer a mere handmaid of medicine, though biochemistry may be regarded as one of the most important factors in the future progress of medicine. The subject is throughout treated in a philosophical manner, and the address will well bear careful perusal.

According to a note in the January number of the Journal of the Franklin Institute, the Forest Service at Washington is watching with interest the substitution of cement for wood as a building material. While the demand for timber has remained almost stationary, the production of cement has increased in the last five years from 25 to 50 million barrels.

Le Radium for January contains a table of radio-active constants compiled by eleven well-known workers in the field of radio-activity. The constants tabulated for each substance are:—the atomic weight, the time constant, the half-decay time, the mean life, the nature of the radiation, the mean path in air of the emitted α rays, the thickness of aluminium which will stop those rays, and the thickness necessary to reduce the β and γ rays to half intensity. The table will be very useful, not only as a record of what is already known, but as an indication of the lacunæ which remain to be filled.

The report of the International Committee on Atomic Weights for 1909 contains a discussion of researches dealing with the atomic weights of hydrogen, chlorine, sulphur, lead, cadmium, tellurium, rhodium, palladium, europium, erbium, ytterbium, columbium, and radium. The changes proposed are:—chlorine, from 35·45 to 35·46; sulphur, 32·06 to 32·07; lead, from 206·9 to 207·1; tellurium, 127·6 to 127·5; palladium, from 106·5 to 106·7; columbium, from 94 to 93·5; radium, from 225 to 226·4. A general revision of the whole table of atomic weights has been made on the basis of the following fundamental data:—when O=16, H=1·008, C=12·000, N=14·007, Cl=35·460, Br=79·916, Ag=107·880, K=39·095, S=32·070. The changes introduced by this re-calculation are small and comparatively unimportant.

Since the time of Prout, the calculation of the atomic weights of the elements by means of a formula has been a favourite speculation. Some of the earlier attempts were considered satisfactory by their proposers if the calculated and experimental values agreed within a unit or two, and were, moreover, usually based on an empirical formula. Two recent attempts in this direction (A. L. Bernouilli, "An Atomic-weight Formula on the Basis of the Law of Mass Action and Avogadro's Law," *Zeitschrift für physikalische Chemie*, January 26, and A. C. G. Egerton, "The Divergence of the Atomic Weights of the Lighter Elements from Whole Numbers," read before the Chemical Society on February 4) fall in a different category. The formulæ are proposed on a definite physical basis, and the values for the atomic weights deduced are very close to the best experimental numbers.

The elastic breakdown of materials submitted to compound stresses forms the subject of articles in *Engineering* of February 5 and 12, contributed by Mr. L. B. Turner. The author discusses the various theories and investigations which have been advanced for ductile materials, the three principal being Rankine's, based on breakdown taking place when a certain maximum tension occurs; Euler's, based on a certain maximum stretch being obtained; and Guest's, based on occurrence of a certain maximum shearing stress. Of these, the first two will not bear the test of experimental investigation; the latter was first enunciated by Guest in the *Philosophical Magazine*, 1900, and was supported by a large number of his experimental results. Mr. Turner has repeated some of Guest's experiments, using weldless steel tubes, which were all annealed under similar conditions in an electric furnace. Nineteen results for combined pull and torque are given, of which two may be disregarded as being abnormal. The remain-

ing seventeen results show a mean difference of 485 lb. per square inch in the maximum shearing stress at breakdown, giving a discrepancy of 3 per cent. only. By calculation from the results of these tests, it is shown that the maximum tension hypothesis is wrong by 50 per cent., and the stretch hypothesis by 35 per cent., taking Poisson's ratio as 0·3. Mr. Turner's experiments may therefore be regarded as giving strong support to Guest's theory. The author proposes to investigate stress of three dimensions, and also to find how far the results obtained for static stress may be applied to the case of stress the magnitude of which is subject to constant variation.

THE twentieth annual issue—that for 1909—of the "Public Schools Year-book and Preparatory Schools Year-book" is now available. Among new features characterising the present volume may be mentioned articles on the universities, giving full details of universities other than Oxford and Cambridge; additional information on qualifying for the Scots Bar and the profession of Writer to the Signet; an article dealing with chemistry as a profession; and a list of lecturers who attend public and preparatory schools. To parents and others selecting either a school or a profession for their boys this enterprising annual should prove invaluable; it is published by Messrs. Swan Sonnenschein and Co., Ltd., and its price is 3*s*. 6*d*. net.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN MARCH:—

March 1.	11h. 32m.	Neptune in conjunction with the Moon (Neptune 2° 37′ S.).
4.	12h. 37m.	Variable star Algol at minimum.
5.	21h. 50m.	Jupiter in conjunction with the Moon (Jupiter 3° 42′ S.)
7.	9h. 26m.	Variable star Algol at minimum.
16.	3h. 3m.	Mars in conjunction with the Moon (Mars 1° 26′ N.).
,,	14h 19m.	Uranus in conjunction with the Moon (Uranus 2° 4′ N.).
20.	13h. 0m.	Venus in conjunction with the Moon (Venus 3° 52′ N.).
21.	23h. 46m.	Saturn in conjunction with the Moon (Saturn 2° 41′ N.).
26.	8h. 54m.	Mars and Uranus in conjunction (Mars 0° 18′ S.).
27.	11h. 8m.	Algol at minimum.
28.	17h. 30m.	Neptune in conjunction with the Moon (Neptune 2° 51′ S.).
30.	8h. 40m.	Red spot central on disc of Jupiter.

A BRILLIANT METEOR AND ITS TRAIN.—A brilliant meteor was seen over a large part of the south of England about 7.30 on Monday evening, February 22. A luminous cloud or streak was visible for a long time after the meteor itself had disappeared. The Rev. F. J. Jervis-Smith, F.R.S., writing from Battramsley House, near Lymington (long. 1° 32′ W., lat. 50° 48′ N.), says:—"At 7.30 p.m. on February 22 my attention was directed by my gardener to a luminous streak or band left by a meteor, which he had seen about twenty minutes before while cycling near Brockenhurst. The streak was not straight, but slightly curved, first towards the north, then to the south, then again to the north, then, turning through about 110° to its mean path, towards the south, it was lost to sight. The streak passed through ϵ Ursæ Majoris and γ Cassiopeiæ. The streak was clearly visible up to 8 p.m. The width of the luminous band covered, roughly, one-eighth of the distance between δ and ζ Ursæ Majoris. The gardener described the luminous head of the meteor as being like the head and shoulders of a whale in shape. While I watched the streak a small meteor crossed the heavens, starting near Polaris, the path being south to north."

Miss Annie L. Waud, observing at Farnham, first observed the luminous appearance at 7.50 p.m. "It was then in Eridanus, and was a glowing streak of light, with two short branches or tails; the streak rapidly moved towards the north-west, the tails growing longer, the upper one gradually spreading through Orion, first through Rigel and then through the belt, finally stretching far beyond and above that constellation. The mass grew fainter as it sank at 8.30 p.m. towards the west, but the upper tail, which was now forked, was distinct until 9.30 p.m."

Dr. T. K. Rose saw this luminous train between Orion and the horizon, at Northwood, "from about 7.45 to between 9 and 10 o'clock, when it was lost in mist near the horizon. It was faint, and could not have been seen but for the brilliance of the night." The apparent shape of the luminous mass changed greatly during this interval, but no nucleus was seen by Dr. Rose at any time. With an opera-glass stars could be seen through the cloud.

QUANTITATIVE MEASURES OF THE WATER-VAPOUR IN THE MARTIAN ATMOSPHERE.—From measures of the relative intensities of the *a*, water-vapour, band in the spectra of Mars and the moon recently obtained by Mr. Slipher at the Lowell Observatory, Prof. Very has derived quantitative results showing the probable ratio between the amount of water-vapour in the Martian atmosphere and the amount of water-vapour in the Flagstaff atmosphere at the time the spectrograms were taken.

The measurements were made with a "spectral-band comparator" devised by Prof. Very, the narrower component of the *a* band, λ 7160–7200, being measured in every case; the relative intensity of the C band was also measured, on each set of spectra, as a check.

The readings given by the comparator were found to be very consistent, but were merely conventional. Reducing these measures so that they represent absolute intensities, Prof. Very finds that the *a* band in the spectrum of Mars is about 4·5 times as strong as in the lunar spectrum, and a further reduction brings out the fact that at the time of exposure the Martian atmosphere must have held in suspension about 1·75 times as much water-vapour as existed in the earth's atmosphere above Flagstaff.

Finally, Prof. Very arrives at the conclusion that whilst the atmosphere above Flagstaff contained sufficient precipitable water to give an average layer of about 8 mm. in depth, the average layer of precipitable water on Mars was about 14 mm.; the mean value for the earth would probably be three or four times as great (Lowell Observatory Bulletin, No. 36).

ABSORPTION OF LIGHT IN SPACE.—In a paper appearing in No. 1, vol. xxix., of the *Astrophysical Journal* (p. 46, January), Prof. Kapteyn discusses one or two phenomena which point to the absorption of star-light during its passage through interstellar space.

That the stars appear gradually to thin out as we recede farther and farther from the solar system is *a priori* evidence that some such absorption exists, otherwise we must assign to the sun a unique position in the universe, that is, the place of maximum density.

In a previous discussion Prof. Kapteyn found a provisional value for the absorption amounting to 0·016 of a magnitude for the distance of thirty-three light-years, as an average for the whole of the sky. Recently obtained results of spectral classification, from Harvard, permitted him to make another attack on the problem by investigating the probable average distances of Miss Maury's two classes of stars of which α Boötis and α Cassiopeiæ are typical. The spectra of the former of these two classes exhibit less general absorption than do those of the latter, and from an analysis of the proper motions given in Newcomb's "Fundamental Catalogue" Prof. Kapteyn finds that, *as a rule*, the proper motions in the α Boötis division greatly exceed those in the α Cassiopeiæ division. This is evidence that they are, as a class, nearer to us, and would, therefore, exhibit less general absorption, if it were due to an absorbing medium, than would the α Cassiopeiæ stars. Thus the present investigation strengthens the probability of the existence of such an absorbing medium.

THE ORBIT OF θ AQUILÆ.—From radial-velocity observations made at the Allegheny Observatory during 1907, Mr.

Baker has derived new elements for the orbit of θ Aquilæ, which he gives and discusses in No. 7, vol. i., of the Publications of the Allegheny Observatory. These elements show the eccentricity of the orbit to be 0.685 ± 0.011, and the period of the binary to be 17.117 ± 0.0042 days. From observations made in 1901–2, M. Deslandres found a period of 16·7 days, and Mr. Baker ascribes the difference to an actual change of the period; the eccentricity is also probably variable.

THE PLANTING OF FRUIT TREES.[1]

MR. PICKERING is playing no new part when, in the recently issued report of the Woburn Fruit Farm, he appears as the demolisher of cherished convictions concerning so fundamental and practical a matter as tree planting. It is an article of faith among fruit-growers that fruit trees must be planted in a certain special way if success is to be obtained. The soil is properly prepared, a large hole is made, wide, but not deep, the roots are carefully spread out in all directions and arranged near the surface, with a slight upward bearing at the ends. The soil is filled in with many precautions. Small quantities of the finer soil are first worked in among the roots, hollow places caused by archings in the stouter roots are filled up, and then the rest of the soil is put in, trodden carefully down, and the whole left to the compacting influence of the rain. The tree is supported by stakes until it is sufficiently firmly established.

All this, according to the report before us, is precisely wrong; it is all exactly the opposite of what it should be. The proper way to plant a tree is to make a small hole, to double the roots up anyhow and stick the tree in, throw in the soil, and ram it down as hard as if one were fixing a gate-post. The experiments seem convincing enough. They have been made at Woburn, Harpenden, Bedford, various places in Cambridgeshire, and in Devonshire; 59 per cent. of the sets showed in favour of ramming, 27 per cent. showed no difference (*i.e.* all the elaborate detail of the ordinary way of planting was simply a waste of time), and only 14 per cent. were against ramming. It makes no difference by what criterion the trees are judged; planting in this new way gives better results than planting in the orthodox fashion.

When a new fact is established by scientific experiment that no longer fits in with the old practical formula which has hitherto sufficed to cover all cases, there is invariably a cry raised about the antagonism of theory (or science) and practice. This has duly happened in the present case. But no practical man has been able to give any reason for the faith that is in him beyond the fact that it is sanctioned by established custom; these appear to be the first serious experiments on the subject, and they do not seem to be vitiated by any constant error. Examination of the trees shows that ramming has led to a copious development of fibrous roots; the photographs here reproduced give an idea, though not an adequate one, of this effect. Direct experiments showed that the fibrous and small roots produced in the nursery before lifting play no great part as roots during the subsequent life of the tree; the important point is to induce fresh root formation, and ramming does this more rapidly than the orthodox method of planting. No harm was done, and sometimes even good resulted, when the old roots were deliberately damaged before planting.

Not rammed. Rammed.
FIG. 2.—Marie Louise.

Not rammed. Rammed.
FIG. 1.—Gascoyne

It is to be hoped that these experiments may be continued on fruit soils of various types. Both the Harpenden and Ridgemont soils are heavier than the typical fruit soils of Kent; it would be interesting to see how ramming works on the brick earths, Thanet and Lower Greensand formations, where so much of our fruit is grown.

The reports issued from the Woburn Fruit Farm are always interesting, because they deal with fundamental problems of universal importance, and not merely with local matters. No fruit-grower could afford to make experiments himself on anything like the scale on which they are carried out at Woburn; and fruit-growers everywhere are under an obligation to the Duke of Bedford and Mr. Pickering for investigating their problems for them and publishing the results in so accessible a form.

E. J. RUSSELL.

[1] Ninth report of the Woburn Experimental Fruit Farm, by the Duke of Bedford, K.G., F.R.S., and Spencer U. Pickering, F.R.S.

POSITION OF THE METRIC SYSTEM.

IT may now be said that the metric system of weights and measures is preferred by every Government in the world outside the British Empire, and that in this advance there has been no retreat.

Its opponents say that though foreign Governments may prefer the reform, it is fairly practised only in a few countries. The truth about this alleged discrepancy between law and popular usage is to be found in two parliamentary papers (Cd. 258 of 1900 and Cd. 435 of 1901), also partly in the records (Paris: Gauthier-Villars, 1907) of the last International Metric Conference, where England had two representatives.

Let us consider, first, the nations which have made least progress. The United States of America have not gone far—far enough, nevertheless, to decide their future, for there is no record of a reverse either in public opinion or practice, except, perhaps, in Turkey, where the Government applied violent coercion to an ignorant populace. Many public Acts of the United States show that their method of progress is to accustom, first their officers and then the public, to the new system before applying it to commerce. Accordingly, it has been introduced with great ease and success into the medical services of the army, navy and public health. There was no trouble, even in the difficulties of war with Spain, when civilian physicians, accustomed only to the old system, were enrolled for service. In some American cities medical prescriptions are by choice almost all metric. Electrical quantities, and to some extent electrical machinery, are metrically described, and metric standards, furnished by the International Bureau at Paris, are alone legal as the ultimate tests of American units. The United States have maintained the metric system in Cuba, Porto Rico, and the Philippines. Russia established it with complete success for all purposes in Finland sixteen years ago, and for the medical services of the Imperial Army and Navy last year. In 1907 it was reported at the International Conference to be spreading "rapidly and without opposition" throughout the Empire under the special direction of Privy Councillor M. Egoroff.

The Chinese Empire may be quoted, like other Governments, as committed to the metric system. After consideration, it has during the past year decided to alter the chief linear unit (chih) to 32 centimetres, as a step towards metric reform, and this was done in face of a petition from 100 British merchants in favour of a British unit.

Japan, also, has recently given effective approval to the metric system by legalising it, teaching it in the primary schools, and using it for the medical services of the army and navy, also for scientific work. At the Paris conference of 1907 "legislation for its definite adoption" was announced to be in preparation. Meanwhile, tens of thousands of metric standards were being issued by the Government. British units are also used for engineering and for imported machinery.

On and after April 1 of next year taxes and customs dues in Denmark will be based on the metric system. The system will become general and obligatory on April 1, 1912.

It is thus seen that these five Powers, the slowest to move, have approved, but do not yet largely practise, the metric system. The rest of the world, outside the British Empire, both approves and practises, excepting Turkey, Greece, some of the smaller South American republics, and various savage regions.

Notwithstanding what has been said above, some anti-metricists declare that even in France the system is largely discarded. The answer to this is that old names are sometimes applied to metric units, *e.g.* the half-kilo. is sometimes called the livre, just as we call twenty-one shillings a guinea, and, secondly, textile goods of English sizes and marks go largely into foreign countries, and are even made there, just as motor-cars and electric machinery of metric size are found in England. There is no sign of metric failure in this, because in a metric country everything is sold metrically.

Even within the British Empire the self-governing colonies are eager for the reform. Australasia and New Zealand have twice urged it upon England, and New Zealand has recently legislated for the purpose. South Africa has suggested it, and the Canadian Government has employed a lecturer to popularise it.

In presence of the above-stated facts, there is obvious danger that England may soon be isolated even from her English-speaking kinsfolk in the matter of weights and measures, notwithstanding the vain suggestion of an Anglo-Saxon conference to improve the British system and retain it in concert with America. There is India, of course, on which we could force any system, wise or foolish, for chaos rules there, and the situation is tolerated partly because full-weight silver coins serve as standard weights, and liquids are generally weighed. The kilogram was legalised for official use and railways on the advice of General Sir R. Strachey in 1871, and the death of Lord Mayo alone prevented its introduction. India deserves better treatment, for it is to her that we owe, through the Arabs, not only the ten numeral figures, but probably also the device whereby both the form and position of each fix its meaning.

The cost and trouble of change are the chief real objections, so it is of the highest importance to remember that metricists do not propose to force the reform into factories, industries, or private life, but only into buying and selling. Cloth, yarn, ironwork, and everything could be made of any size or weight, but in the market such size or weight, if stated, would have to be in metric figures. There would be no alteration of count, number, pattern, or mark under which cloth, yarn, screws, &c., are often sold. In private life the glass of beer, the teaspoonful of medicine, &c.. would remain.

Shopkeepers and merchants, probably also railways, would be compelled to use new weights and yard sticks, and their example would quickly educate the whole country. No more than this limited compulsion was proposed to Parliament in 1907, but objectors presented estimates of cost based on universal compulsion, and the result was an adverse vote of 150 against 118. The House of Commons had not then before it the evidence afterwards given at the Paris International Conference, that commerce can be metric without impeding industry.

There is, however, a considerable class of people who can never be converted except perhaps by fear of international isolation. Therefore, pending another attempt at legislation, the converted should practise their faith rather than preach it to the deaf. Scientific societies and scientific departments of State could favour metric usage, as the British Medical Association is now doing, and as the Government might do in the medical services of its army, navy, and public health, unless it distrusts the American experience above stated.

In meteorology, geology, and cartography there is much room for advance, excepting the excellent maps with scales of 1/2500 and 1/5000.

There is not space here for the long array of great names which support this reform, and it ought to be needless to state that the system does not embrace angles, time, navigation, thermometry, money, or anything but measures of length, surface, volume, and weight. Nevertheless, it may be mentioned that one of its principles, the counting by tens, which abolishes compound arithmetic, would save here, as in all foreign countries, a vast total of human energy, especially in application to money. It is estimated that in the Custom House alone decimalised money would save 20,000*l.* a year.

BIRD-LIFE.

THE feeding-habits of the dunlin form the subject of a paper—based on close personal observation—contributed by Mr. J. M. Dewar to the January number of the *Zoologist.* In surface-feeding these attractive birds search for small organisms floating in the wash of the sea or carried seawards by the shore-streams, as well as for minute insects and spiders on the sand or mud, although the main objects of their quest are tiny univalve molluscs, with the shells of which their gizzards are always crammed. Dead shells, which form a large proportion of those on most shores, are left alone. Dunlins also probe the sand or mud for bivalve molluscs and worms. Both in the act of tapping and probing the two halves of the

beak appear to be slightly separated; it is also probable that the separation increases with the depth of the probing, although the upper and lower portions remain nearly parallel until they are thrust in to their extreme limit, when the terminal part of the upper one becomes expanded at the moment of contact with the "find."

The already overcrowded list of so-called British birds has been increased by the capture, on Fair Isle in September, 1908, of a specimen of Eversmann's warbler (*Phylloscopus borealis*). This bird, which is really a dark-coloured willow-wren, has been recorded once in Heligoland, in 1854, but its normal summer haunts are Finmark, northern Russia, and Siberia, while in winter it wanders to Burma, Malaya, and China. Fuller details of the capture will be found in the January number of Witherby's *British Birds*.

Captain Stanley Flower and his assistant, Mr. M. J. Nicoll, have drawn up a list of the species of wild birds which have been observed to visit the zoological gardens at Giza during the period between October, 1898, and October, 1908. This list, which has been published by the Egyptian Government, comprises no less than 166 species, eleven of which are, however, not indigenous to the country, and were accordingly, in all probability, represented by imported individuals. The very large number, both as regards species and individuals, which visit the establishment adds considerably to the attractions of the Giza Gardens, and the list has been published in response to inquiries from visitors as to their names. It is a prevalent idea that song-birds are lacking in Egypt, but a visit to the gardens when the nightingale and the rufous and olive warblers are singing will at once dispel this illusion.

In the report of the vertebrate section of the Yorkshire Naturalists' Union for 1908 reference is made to the appearance of a flock of Pallas's sandgrouse on the northern slope of the wolds during the autumn of that year. The great grebes on Hornsea Mere have been reduced to three, and it is believed that the diminution is mainly to be attributed to egg-collectors and other visitors. The peregrine falcons again built on Bempton Cliffs, where they reared a single young one.

The birds of the Barotsi district of the Zambesi form the subject of a paper by Mr. A. Sandberg in vol. vii., part ii., of the Proceedings of the Rhodesia Scientific Association. As an illustration of the teeming bird-life of the great valley, the author writes that "the traveller encounters enormous numbers of geese, ducks, and wading birds in wonderful variety of species, size, and coloration, and the sand-banks of the river, upon which they find a refuge, present an appearance at times which can best be described as kaleidoscopic. Above the almost deafening din of their shrill voices can be distinguished the incessant cry of the fish-eagle, for ever on the alert for prey."

PREHISTORIC ARGENTINA.[1]

THE pottery described in the first of the papers mentioned below was mainly obtained in the province of Catamarca. The specimens are illustrated by handsome coloured plates drawn from photographs. The earliest type includes bowls and jars, ornamented in white, red, and black in imitation of the woven patterns of basket-work. Similar ornamentation is found in the baskets, cloth, and pottery of New Mexico and California. Another type, with red and black colouring, shows either geometrical designs or outlines of animals, especially frogs and snakes, usually conventional in character. Among the objects depicted are the anura, *Ceratophys ornata* and *Leptodactylus ocellatus*, and the ophidia *Elaps frontalis* and *Lachesis alternatus*, as well as the rhea and puma and a fern, a species of Hymenophyllum. There are also crude representations of human beings.

The second article describes two human faces in terra-cotta, and part of the head of an animal supposed to be the coyote (*Canis cagottis*), in the same material. These were found in a high bank in the Laguna de Lobos, in the province of Buenos Aires. They are so closely similar to the earthenware "masks" found in such numbers in the ancient ruins at San Juan de Teotihuacan, in Mexico, that the author believes that they were manufactured there, but he declines to advance any theory to explain their presence in the Argentine.

The third paper deals with implements and fragments of pottery collected by Señor Carlos Ameghino on the site of a prehistoric settlement in the extreme south of the province of Buenos Aires, and distant 5 kilometres from the sea-shore. They were found on the surface at the foot of unconsolidated sand-dunes, and include flakes, scrapers, chisels, knives, arrow-heads, and grinding stones, all primitive in character. These appear to have been manufactured from ellipsoidal beach-stones, mainly jasper, though phonolite, chert, porphyritic breccia, and other materials were also employed. The grinding stones are of hard grit ("asperón").

The pottery was moulded of a sandy clay, and imperfectly baked. It was ornamented with grooves and pits made with the nail or a fragment of wood.

The collection indicates, we are told, a culture similar to that which still characterises the middle and lower parts of the basin of the Rio Negro, certain localities in the government of the Pampa, and the southern plains of the province of Mendoza. It presents many points of resemblance to that met with in the southern part of the government of the Rio Negro and in the governments of the Chubut and Santa Cruz, but differs completely from that of the rivers Salado, San Borombón and Luján, and generally the eastern portion of the province of Buenos Aires.

J. W. E.

[1] (1) Alfarerias del Noroeste Argentinto (Anales del Museo de La Plata, series ii., vol. i.). Pp. 5 to 40.
(2) Sobre el Hallazgo de Alfarerias Mexicanas en la Provincia de Buenos Aires (Revista del Museo de La Plata, vol. xv., series ii., vol. ii.). Pp. 284 to 293.
(3) Arqueologia de San Blas (Anales del Museo Nacional de Buenos Aires, vol. xvi. (series iii., vol. ix.). Pp. 249 to 275. All by Señor F. Outes.

THE INCREASED EXPANSION OF STEAM ATTAINABLE IN STEAM TURBINES.[1]

I FIND it difficult to add anything to the words of the many illustrious men who have addressed this society on previous anniversaries of the birth of James Watt, to the words of Sir Humphry Davy, Lord Aberdeen, and Lord Jeffrey, and in later years to those of Joule, Scott-Russell, Preece, and Kelvin. This evening I should prefer to recall to your memories the fundamental principles of steam discovered by James Watt, and to endeavour to trace their application in the engines constructed by him and by the firm of Bolton and Watt, then in the more highly developed forms of compound, triple, and quadruple reciprocating engines, and, lastly, in steam turbines on land and sea.

The laws of steam which James Watt discovered are simply these, that the latent heat is nearly constant for different pressures within the ranges used in steam engines, and that, consequently, the greater the steam pressure and the greater the range of expansion the greater will be the work obtained from a given amount of steam, and, secondly, as may be seen to us now as obvious, that steam from its expansive force will rush into a vacuum.

Having regard to the state of knowledge at the time, his conclusions appear to have been the result of close and patient reasoning by a mind endowed with extraordinary powers of insight into physical questions, and with the faculty of drawing sound practical conclusions from numerous experiments devised to throw light on the subject under investigation. His resource, courage, and devotion were extraordinary, and drew to his side a coterie of kindred spirits, with whom he discussed freely his theories and his hopes, and the results of his experiments.

In commencing his investigations on the steam engine, he soon discovered that there was a tremendous loss in the Newcomen engine which he thought might be remedied—the loss caused by condensation of the steam on the cold metal walls of the cylinder. He first commenced by lining the walls with wood, a material of low thermal conductivity. Though this improved matters, he was not satisfied; his intuition doubtless told him that there should

[1] The James Watt lecture delivered at Greenock by the Hon. C. A. Parsons, F.R.S.

be some better solution of the problem, and doubtless he made many experiments before he realised the true solution in a condenser separate from the cylinder of the engine. It is easy after discovery to say how obvious and how simple, but many of us here know how difficult is any step of advance when shrouded by unknown surroundings, and I can well appreciate the courage and the amount of investigation necessary before James Watt thought himself justified in trying the separate condenser.

But to us now, and to the youngest student who knows the laws of steam as formulated by Carnot, Joule, and Kelvin, the separate condenser is the obvious means of constructing an economical condensing engine.

Watt's experiments led him to a clear view of the great importance of securing as much expansion as possible in his engines. The materials and appliances for boiler construction were at that time so undeveloped that steam pressures were practically limited to a few pounds above atmospheric pressure. The cylinders and pistons of his engines were not constructed with the facility and accuracy with which we are now accustomed, and chiefly for these reasons expansion ratios of from two- to three-fold were the usual practice. Watt had given to the world an engine which consumed from five to seven pounds of coal per horse-power hour, or one-quarter of the fuel previously used by any engine. With this consumption of fuel its field under the conditions prevailing at the time was practically unlimited. What need was there, therefore, for commercial reasons, to endeavour still further to improve the engine at the risk of encountering fresh difficulties and greater commercial embarrassments? The course was rather for him and his partners to devote all their energy to extend the adoption of the engine as it stood, and this they did; and to the Watt engine consuming from five to seven pounds of coal per horse-power mankind owes the greatest permanent advances in material welfare recorded in history.

The Watt engine, with secondary modifications, was the prime mover in most general use for eighty years until the middle of the last century, when the compound engine began to be introduced. Why, we may inquire, was it that the compound engine was so long in coming into use, for it had been patented by Hornblower in 1781, or seventy years before? and why does John Bourne in his large book, "Practical Instructions for the Manufacture and Management of every Species of Engine," published 1872, make no mention in the index of the compound or triple expansions, and when he speaks of Hornblower's double-cylinder engine (really a compound engine) does he do so in disparaging terms, mentioning that there was no increased economy in steam over the single cylinder? This last statement provides an answer to our inquiry, for it is correct in view of the very low steam pressure in general use before that time, or until somewhat before the middle of the last century, when the introduction of the locomotive led to a general rise in pressures on land, and the surface condenser some years later to increased steam pressure at sea. Also, we must remember that many experiments have shown that unless the mean difference of pressure on a piston exceeds about 7 lb. per sq. inch, the friction, the bulk, the momentum of the moving parts, and the cost make such a cylinder not worth having. The case, however, with the turbine is entirely different, and it is chiefly owing to this difference and to its power of usefully expanding the steam down to the very lowest vapour pressure attainable in the best condenser that it has surpassed the best reciprocating engines in economy of steam. To return to our subject. The introduction of the compound, triple, and quadruple expansion engines was therefore concurrent with the improvements in boiler construction, the introduction of the surface condenser, and the general rise in steam pressure, and by the quadruple engine the expansion ratio has been extended up to about sixteen-fold, and the consumption of coal per horse-power reduced to from $1\frac{1}{4}$ lb. to $1\frac{1}{2}$ lb. per horse-power hour, or to from one-fourth to one-third the fuel consumed in the time of James Watt. Let us now direct our attention to the turbine engine, which derives its power, not from the pressure of the steam on a piston, but from the momentum of the steam at high velocity curving around and blowing forward the vanes or paddles attached to the shaft.

It is unnecessary here to recapitulate the many attempts to construct a successful steam turbine from the days of Hero until a quarter of a century ago, as several excellent books are now published on the subject. It is true that the difficulties of construction and inferior workmanship available during this early period were a serious bar to progress, but the chief bar to progress lay in the fact that the turbine, to be economical in steam, must (at least in its primitive form) rotate at a very high speed, and that before 1880 there was no commercial use for such a high-speed engine excepting through the intermediary of belts or friction gearing, or for such exceptional purposes as the direct driving of circular saws. The chief purpose for which turbines are now extensively used on land did not then exist, namely, for the driving of dynamos. Then, again, belts for high speeds are a very unsatisfactory appliance, and accurately cut spiral gearing as recently introduced by Dr. de Laval had not been devised; and, again, the problem of applying a turbine to the propulsion of vessels being surrounded, as it was, with great consequential difficulties would naturally only be attacked after the successful application of the prime mover to some easier and simpler purpose on land, so that I think, on the whole, we may safely say that under the conditions prevailing the commercial introduction of the turbine before 1880 was a practical impossibility.

It is a matter of history that the turbine principle had been used for obtaining power from waterfalls before the days of James Watt, but I am not clear that he had in mind any concrete form of steam turbine; yet in 1770 he suggested "a circular engine consisting of a right-handed and left-handed bottle-screw spiral involved in one another," and he also appears to have had a leaning towards some form of directly rotary engine, for in 1769 he took a patent for a Barker's reaction water-wheel, the water pressure being derived from the action of steam on water, as in Savery's fire-engine or a modern pulsometer. He also designed a rotary abutment engine in 1782, but in none of these machines is there any indication of an attempt to gain greater expansion ratios for the steam.

It is peculiarly interesting to recall on this occasion that one of the earliest steam turbines to be put to practical work was in this town; it was about the middle of the last century, and was a turbine like that described by Branca in 1629. It consisted of a steam jet playing upon a paddle-wheel, coupled to a circular saw, which it drove for some years. The principle of the expansive working of steam was, however, only to a small extent utilised in this engine, for I believe that the steam jet was non-divergent, which implies a useful expansion ratio of only about $1\frac{1}{2}$-fold. One of the most conspicuous workers in the design of the compound turbine was Robert Wilson, of Greenock, Master of Arts of Edinburgh, who lodged a patent in 1848. This patent was of unusual length and wealth of detail, and describes radial-flow and parallel-flow compound turbines, designed for moderate ratios of expansion. The blades and guides were proposed to be fastened by casting them into the hub and case, a method occasionally used at the present time.

The principles of Wilson's design are generally correct, but the proportions of his turbines are extravagantly incorrect, the blades being too large and too few for success. I had a model made of Wilson's turbine eighteen years ago, and under steam all that could be said was that it went round the right way. I do not think that Wilson can have made a model and tested it before he applied for his patent, the course followed by James Watt, and one which is to be strongly recommended to the attention of inventors generally in almost all circumstances, as saving time, money, and disappointment. There have been many workers on steam turbines of English nationality before and since the time of Wilson, but within the last twenty years other countries have taken up the subject with zest.

Prior to 1880 the uses for a very high-speed motor were few, as we have seen; the speed of revolution of steam wheels, as Bourne described them in 1872, "was inconveniently high for most purposes," but after 1880 conditions were changed; the beautiful machine, the milk separator, of Dr. de Laval, of Stockholm, and the great invention of the dynamo electric machine had come, and

required a high-speed prime mover to drive them, and these provided encouragement to the workers on steam turbines; thus between 1884 and 1888 we find the practical and successful realisation in altered and correct proportions of ideas and suggestions of previous workers, the compound steam turbine in 1884 applied to the direct driving of dynamos, and the single-stage impulse wheel in 1888, of very high velocity, played upon by the expanding steam jet, both types possessing great ratios of expansion.

All steam turbines now in practical use expand the steam usefully over nearly the whole range from the boiler pressure to the pressure in the condenser, and their designs are based on the principles involved in the construction of their prototypes of 1884 and 1888.

There is, first, the compound turbine, the characteristic feature of which is the gradual expansion of the steam by small drops of pressure at each turbine of a long series of turbines of gradually increasing volumetric capacity, as in the Parsons, or a somewhat less gradual expansion with greater drops of pressure at each stage, as in the Rateau, Zoelly, and others.

Then there is the expansion by the divergent jet in one stage, as in the de Laval, or an expansion in a relatively small number of stages by expanding jets playing upon rows of buckets with intermediate rows of reaction guides, as in the Curtis and Reidler-Stumpf.

Then there are combinations of the first and second, where the first stage of the expansion is affected by, say, a Curtis element, and the rest by a Parsons, and many other combinations have also been proposed, too numerous to mention here.

Let us consider these principal examples of the turbine principle more closely. In the compound turbine the velocities of the steam are low; at each passage through the blades it expands a little, yet it obeys, as regards the velocity of efflux, approximately the laws of flow of fluids; but the aggregate of the small expansions soon becomes apparent, and has to be taken into account when reckoned over a considerable number of the series of elemental turbines. For instance, if the expansion ratio for a single turbine of the series be as 1 to 1·03 in volume, a 3 per cent. expansion, then after passing through twenty-three turbines its volume will be doubled, and the velocity of flow through the guide blades and moving blades (presuming they are of equal area of passage way) will be about 230 feet per second. The velocity of the blades is, generally speaking, about half the velocity of the steam at issue, and will therefore, in this case (which I have taken as common in marine practice), be about 115 feet per second.

The difference in velocity of the steam and the blades is smoothed over largely by the curvature of the blade, which somewhat resembles a shallow hook around which the stream lines in the steam arrange themselves with very little shock or eddying in the steam, so that the coefficient of efficiency is high.

In turbines for driving dynamos and other purposes where higher speeds of revolution are permissible, steam velocities up to 600 feet and blade velocities up to 300 feet per second at the exhaust ends are general.

In turbines of the Rateau, Zoelly, and other types with multiple discs, each disc carries one row of blades only, and works in a cell, through the walls of which the shaft passes in a steam-packed gland; nearly the whole drop in pressure takes place at the guide vanes, and very little at the moving vanes, which are of cup form; the velocities of the steam generally range from 900 feet to 1100 feet per second, and the velocities of the blades from 350 feet to 450 feet per second. In turbines, however, of the de Laval single-wheel and of the Curtis and other types with a relatively small number of pressure stages, higher steam velocities are used, ranging from 4200 feet per second in the single-wheel down to 1500 feet in a seven-stage Curtis turbine. The jets used in the single-stage turbine are of very divergent form, but when the expansion is divided over seven stages very little divergence is necessary.

In the single-stage turbine, blade velocities so high as 1200 feet per second are adopted, the discs being of taper form and of the strongest nickel-steel; but even this high velocity is insufficient to obtain a very good coefficient of efficiency from the steam, and when the disc is made large, so as to reduce the immense angular velocity incidental to the high peripheral speed, the skin friction of the disc and the prime cost and weight increase rapidly.

In the Curtis five-stage the blade velocities are about 460 feet per second, and the steam velocity about 2000 feet per second, and by the passage of the steam through two rows of moving and one row of guide blades between them at each wheel the steam is brought nearly to rest before passing on to the next succeeding chamber, and by this sinuous treatment of the steam efficiencies are obtained comparable to those of the compound turbine.

From the commencement of turbine design in 1884 I have avoided the adoption of high steam velocities on account of their cutting action on metals when any water is present. The cutting has been found to be due, not to the impact of gaseous steam, but to that of minute drops of water entrained by the steam, and hurled by it against the surfaces. The drops, formed like fog, consequent on the expansion of saturated steam, are sufficiently large to cause the erosion. To test the effect in an extreme case, a hard file was placed opposite to a jet of steam issuing at 100-lb. pressure into a vacuum of 1 lb. absolute pressure; in 145 hours it was found to be eroded to the extent of about 1/32 inch, as if it had been sand-blasted. The calculated velocity of the issuing steam in this case is about 3800 feet per second, and the striking fluid pressure of a drop of pure water at this velocity about ninety tons per square inch. Owing, however, to the receding velocity of the blades from the blast in all turbines, the erosive effect is much reduced. In multicellular turbines of few stages, though the erosion is slow, yet provision is necessary for renewal of blades at intervals. In turbines of many stages it is still slower, and in the compound turbine erosion is, practically speaking, absent, and renewal of blades unnecessary. This absence of the tendency to erosion in compound turbines permits the use of brass or copper blades, which are found to preserve their polish and are not liable to corrosion or rusting, and preserve their smoothness of surface and the initial economy of the engine unimpaired for many years.

It is now just fifteen years ago, and exactly ten years from the commencement of work on the compound steam turbine, that the results obtained on land were thought to justify an attempt to apply the turbine principle to the propulsion of vessels. These results lay in the fact that a condensing turbine engine of 200 horse-power, with an expansion ratio of 90 volumes, had been found to have equal economy to a good compound piston engine, and that, besides, there were within sight reasons to hope for still better results. A commencement was made, and by the end of 1897, after three years of hard work and experiment, the *Turbinia* was completed. Her trials were usually made on the measured mile in the North Sea, but occasionally, when the sea was too rough, runs at speeds up to 31 knots were made on the Tyne, where the legal limit of speed of steamships was 7 knots, and by the magnanimity of the Tyne Improvement Commissioners the completion of the *Turbinia* was greatly facilitated, though it is fair to say great care was exercised and no harm done to the public. In her the problem of adapting the turbine to the screw propeller was worked out. The result was a compromise between the two. The turbine had to be made short and broad, so as to revolve as slowly as possible, and the screw had to be made with finer pitch and wider blades. The result in propulsive efficiency was found to be good, and the problem satisfactorily solved for fast vessels of 16 knots and upwards, and it was also seen that the faster the vessel the more favourable would be the economy of the turbine as compared with the reciprocating engine.

The destroyers *Viper* and *Cobra* followed. The next step was the application of the turbine to vessels of commerce.

Dumbarton was the scene of many conferences. Mr. Archibald Denny was deeply interested in the problem, and so was Captain John Williamson, with the result that the first passenger vessel, the *King Edward*, was built in 1901 at Dumbarton to the joint ownership of Captain John Williamson, Messrs. Denny, and the Parsons Marine

Steam Turbine Co., Ltd. The success of this vessel soon led to the adoption of turbines in cross-Channel steamers, and also led, aided by the success of the destroyers *Viper* and *Velox*, to the specification of turbines in H.M.S. third-class cruiser *Amethyst*, and from that time turbines began to be rapidly adopted for fast vessels, including the largest and fastest mercantile and war vessels afloat.

The success of the *King Edward* in 1901 was a red-letter day for the marine turbine. Let us inquire in what this success consisted. In the first place, a factor of primary importance is the coal bill, and it was soon proved by Messrs. Denny that this was less to the extent of from 5 per cent. to 25 per cent. than with vessels propelled by reciprocating engines of equal displacement and carrying capacity. Also the cost of oil, which with reciprocating engines amounts to about 5 per cent. of the coal bill, was nearly eliminated; the vibration was also less. Then the upkeep of machinery was found to be favourable, and as the crew became accustomed to her the coal consumption still further diminished, and I am informed by Captain Williamson that this further decrease has been well maintained up to the present time. The exceptional trustworthiness of the machinery also became more and more assured.

There are now about 120 vessels actually on service fitted with turbines, and seventy more under construction, representing a total horse-power of marine turbine engines of about 2,250,000, of which 1,250,000 horse-power is completed.

There were two other great steps in the adoption of the turbine, which occurred almost simultaneously in 1905, namely, the decision of the Admiralty to adopt turbines for all new construction in fighting ships, and the adoption of turbine machinery for the great Cunarders. The steps from the second-class cruiser *Amethyst*, of 15,000 horse-power, to the *Dreadnought*, of 22,000 horse-power, and to the *Indomitable*, of 41,000 horse-power, were, it is true, gradual, but the number of vessels involved was great. In the mercantile marine the step from the *Queen*, the first cross-Channel vessel, of 8000 horse-power, directly to the *Lusitania* and *Mauretania*, of 70,000 horse-power, required great courage on the part of the late Lord Inverclyde and his co-directors and engineers. Such steps as these are not taken without thorough investigation based on ascertained results. When it is considered that the low-pressure turbine in the *Queen* was 6 feet in diameter, 20 feet in length, and 25 tons in weight, as compared with the Cunarders' low-pressure turbines of about 17 feet 6 inches diameter, 50 feet in length, and 300 tons weight, it is realised what a great departure was involved; forces and conditions were altered; differential expansions and deflections of the structure had all to be re-considered in detail, for though they had been successfully dealt with and controlled in the smaller engine, the magnitude of the larger structure rendered re-calculations and thorough investigation necessary; thus no room was left for the possibility of any adverse conditions arising, due to the very great increase in the size of structure, and everything that care, thought, and experience could accomplish was done, and the results have satisfactorily agreed with the hopes and estimates of all concerned.

In the *King Edward* there was a great increase in the ratio of expansion beyond that hitherto realised in any reciprocating engine. Her boiler pressure is 150 lb., and the pressure at the inlet to the turbines at normal full speed 130 lb.; the pressure in the condenser is $1\frac{1}{2}$ lb. absolute, a ratio of 87 by pressure or about 66 by volume, as compared with the volumetric ratio of about 10 in triple-expansion reciprocating engines for a similar class of vessel.

In some later turbine vessels higher steam pressures have been adopted, resulting in a small gain in efficiency, partly counterbalanced by the greater weight of the turbine cases, and if the vessel has Scotch boilers, then also by the greater weight of the boilers to carry the greater pressure; and on the whole the net gain, if any, is but small.

A substantial increase in efficiency has, however, been realised by improvements in condensers and pumps, in order to take full advantage of the property of the turbine of expanding steam usefully to the lowest pressure attainable in the condenser. Before the turbine came into use a very high vacuum was not found desirable, for the simple reason that the reciprocating engine is unable to utilise it. For instance, a triple-expansion engine does not gain in economy of coal if the absolute pressure in the condenser be diminished below $2\frac{1}{2}$ lb. The turbine, however, derives a net gain in efficiency of 13 per cent. from a diminution of pressure in the condenser from $2\frac{1}{2}$ lb. absolute to 1 lb. absolute.

The improvements that have been introduced of late years in condensing plants consist primarily in improved design of the condenser and in improvements in air pumps to increase their volumetric capacity. In the condenser the tubes are so spaced and grouped that the steam, attenuated into relatively an enormous volume, shall pass freely without much resistance and drop of pressure throughout the whole surface, and provision is made by the form of the condenser shell, with or without a single baffle plate, so that the suction of the air pump shall remove the air uniformly from all parts. The vacuum now usually obtained in well-equipped turbine vessels is very close to that corresponding to the temperature of the circulating water leaving the condenser. The difference is sometimes so small as two degrees, so that there is no room for much further improvement in this direction. To increase the volumetric capacity of the air pumps, dry air pumps run at a high speed may be used, separate pumps being employed to remove the water of condensation. An alternative, and perhaps a preferable method, is the vacuum augmenter, a simple apparatus without moving machinery, which consists of a very small steam jet placed in a narrowed portion of the ordinary air-pump suction, which sucks the air out of the condenser and compresses it through a small intermediate cooler into the suction of the air pump, the water of condensation draining by gravity through a water seal into the same air-pump suction.

Further possible improvements would therefore seem to tend in the direction of an increase in the efficiency of the turbine itself. In large turbine vessels the ratio of the shaft horse-power to the total available energy in the steam from boiler to condenser reaches 70 per cent., and the question is whether there is a probability of somewhat reducing this loss of 30 per cent.

During the last eleven years a small reduction in steam per horse-power delivered to the shaft has been brought about by minor improvements in design, better finish and proportion of the blading, and by the increased size of the engine constructed.

In 1897 the *Turbinia* consumed 16 lb. per shaft horse-power for all purposes; in 1901 the *King Edward* consumed 16 lb. per shaft horse-power for all purposes; in 1907 the *Lusitania* consumed 12 lb. per shaft horse-power for all purposes; and the *Mauretania* consumed 11·5 lb. per shaft horse-power for all purposes.

In the case of slow vessels, where the exigencies of the screw propeller limit the revolutions to a low rate, I have for many years advocated a combination or partnership between the reciprocating engine and the turbine which seemed to promise a high degree of efficiency and to suit all the requirements of the case. In this combination each engine deals with that part of the expansion for which it is best suited, the reciprocating engine taking the high-pressure portion from the boiler pressure down to about atmospheric pressure, and the turbine carrying on the expansion from about atmospheric pressure right down to the condenser pressure.

The reciprocating engine is thus relieved of the low-pressure part of the expansion, which at best it carries out in a very inefficient manner, losing as it does all the last part, and the turbine is relieved from the high-pressure part, which when constructed for slow revolutions it performs unsatisfactorily; but the turbine designed for low pressures and slow revolutions is an engine which converts a very high percentage of the power in the steam into shaft horse-power.

Messrs. Denny have fitted the *Otaki*, of 8000 tons, 5000 horse-power, and 13 knots sea speed, with this system, the boiler pressure being 200 lb., no superheaters being fitted, and the very low consumption of 12·3 lb. of steam for all purposes was registered on trial. Messrs. Harland and Wolff are also fitting a vessel for the Dominion Line on this system.

James Watt, we are told, suggested the screw propeller in 1770; half a century later it commenced to come into use, and now it is almost universally adopted in all new construction.

It is a very interesting and curious fact to note that in the first instance, and for many years, the screw was driven by spur gearing from a very slow-speed engine, presumably because the builders of engines were afraid to design the engines to run so fast as the screw required to be driven. Now for forty years or more gearing has been entirely abandoned, and the high-speed reciprocating engine has worked well.

The turbine has now come on the scene, and its best speed of revolutions is faster than that of the screw, excepting in fast vessels; for the larger portion of the tonnage of the world it is at present unsuited, except to take a secondary but excellent part in the combination system.

We may naturally speculate as to the future, and inquire if there is a possibility of the turbine being constructed to run more slowly and without loss of economy, or whether the propeller can be modified to allow of higher speed of revolution.

Or, again, may a solution be found in reverting to some description of gearing, not to the primitive wooden spur gearing of half a century ago, but to steel gearing cut by modern machinery with extreme accuracy and running in an oil bath, helical tooth gearing or chain gearing, or, again, some form of electrical or hydraulic gearing?

These are questions which are receiving attention in some quarters at the present time, and if a satisfactory solution can be found, then the field of the turbine at sea will be further extended.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—It is proposed to confer the honorary degree of Sc.D. on Dr. Sven Hedin on Thursday, March 4. Dr. Sven Hedin will lecture before the Senate on that date in the Senate House. Before the ceremony he will be entertained at lunch by the master and fellows of Gonville and Caius College.

The Isaac Newton studentship, tenable from April 15, 1909, to April 15, 1812, has been awarded to Mr. W. J. Harrison, of Clare College.

The Lowndean professor, Sir Robert Ball, F.R.S., will lecture on "Ancient and Modern Views of the Constitution of the Milky Way" before the Cambridge Antiquarian Society on Monday, March 1, at 4.30 p.m.

In July of last year letters signed by the Chancellor were sent to more than 300 universities, colleges, academies, and other corporate bodies, inviting them to appoint delegates to attend the Darwin celebration from June 22–24 next. In answer to these invitations more than 200 delegates have been appointed. The expense likely to be incurred in carrying out the programme amounts to considerably more than 500*l.*, but it is hoped that it may be possible to provide the excess above that sum by private subscriptions, and the Senate will therefore not be asked to authorise the expenditure of more than 500*l.* from the University chest.

MR. E. C. WILLS has given 10,000*l.* to the Bristol University Fund, thus raising the fund to practically 200,000*l.*

WE learn from a recent number of *Science* that Mrs. E. G. Hood has given the University of Pennsylvania 20,000*l.* to establish graduate fellowships in the law department. Mr. Adolphus Busch, who last August promised to contribute 10,000*l.* towards the 60,000*l.* necessary for the erection of the new building for the Germanic Museum at Harvard University, has increased his gift to 20,000*l.* The General Education Board has offered to give Bryn Mawr College 50,000*l.* on condition that friends of the college subscribe 56,000*l.* by June, 1910. This is in addition to the 20,000*l.* recently given by the alumnæ. Of this sum, 26,000*l.* is to be used to pay the debt of the college, and the balance is to be reserved as an endowment fund.

A ROYAL COMMISSION has been appointed to consider the position and organisation of university education in London. The terms of the reference to the commission are:—to inquire into the working of the present organisation of the University of London, and into other facilities for advanced education (general, professional, and technical) existing in London for persons of either sex above secondary-school age; to consider what provision should exist in the metropolis for university teaching and research; to make recommendations as to the relations which should in consequence subsist between the University of London, its incorporated colleges, the Imperial College of Science and Technology, the other schools of the University, and the various public institutions and bodies concerned; and further to recommend as to any changes of constitution and organisation which appear desirable. In considering these matters, regard should also be had to the facilities for education and research which the metropolis should afford for specialist and advanced students in connection with the provision existing in other parts of the United Kingdom and of His Majesty's dominions beyond the seas. The chairman of the commission is Mr. R. B. Haldane, K.C., M.P., and the other members are Viscount Milner, G.C.B., G.C.M.G., Sir Robert Romer, G.C.B., Sir R. L. Morant, K.C.B., Mr. Laurence Currie, Dr. W. S. M'Cormick, Mr. E. B. Sargant, and Mrs. Creighton. The joint secretaries are Mr. J. Kemp and Dr. H. F. Heath.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 28.—Mr. A. B. Kempe, treasurer, in the chair.—The action of the venom of *Sepedon haemachates* of South Africa: Sir T. R. **Fraser** and Dr. J. A. **Gunn.** —The colours and pigments of flowers, with special reference to genetics: Miss M. **Wheldale.** The communication gives an account of investigations made upon plant pigments, with a view to the elucidation of phenomena observed in the genetics of flower-colour. A primary classification is made into plastid pigments and pigments soluble in the cell-sap. Of the former, several kinds are shown to exist, in addition to carotin and xanthin. When the type of a species contains more than one plastid pigment, the power to produce each pigment is expressible as a Mendelian factor. Loss of the factors in turn gives rise to varieties of the type. Soluble pigments are classified as red-purple-blue (anthocyanin) and yellow (xanthein) and of both; various kinds can be differentiated by means of chemical reagents. There is evidence, moreover, of a relationship between the behaviour of the pigments in genetics and their chemical reactions. Colourless tannin or glucoside-like substances are found to be widely distributed in plants, and such substances appear to take part in the formation of some kinds of anthocyanin. This conclusion is based upon examination of pigments of varieties of *Antirrhinum majus*, of which the inheritance of flower-colour has been worked out by the author (previous communication to Roy. Soc.); the results of the present paper show that in this genus both a glucoside-like substance and a reddening factor are essential to the production of anthocyanin of the type. Loss of glucoside gives rise to an albino variety still capable of carrying the reddening factor; loss of the reddening factor gives a variety bearing ivory-white flowers, distinguishable from the albino, and containing the glucoside. Experiments on the same genus further indicate that the xantheic pigment of a yellow variety is a derivative of the glucoside of the ivory-white, to which it is also hypostatic. Examples are given of genera resembling Antirrhinum in their series of varieties derived from the anthocyanic type, and also of genera forming another series, from which the xantheic variety is absent. In this connection, stress is laid upon the conception of two forms of albinism, one due to loss of anthocyanin only, the other to loss of both anthocyanin and xanthein.—The variations in the pressure and composition of the blood in cholera, and their bearing on the success of hypertonic saline transfusion in its treatment: Prof. L. **Rogers.** This communication contains some points of

interest in physiology, pathology, and therapeutics. The blood of Bengalis has been found by Captain Mackay to contain a higher proportion of salts and a less proportion of red blood corpuscles than the blood of Europeans. The author has found that the blood pressure in the natives is lower than in Europeans, averaging about 100 millimetres of mercury. The pathological observations are that in cholera the enormous secretion of fluid into the bowel drains away the fluid part of the blood. There is a very definite relationship between the amount of fluid thus lost from the blood and the severity and mortality of the disease. Injections of normal saline solution (0·65 per cent. of NaCl) into the veins have an almost miraculous effect in relieving the symptoms and restoring the patient to apparent health. This improvement is, however, only transient, and in the course of a few hours the symptoms recur and the patients die. It occurred to the author that if, instead of using a normal saline solution, he were to inject a hypertonic solution of 1·35 per cent. NaCl into the veins, there would be less likelihood of the diarrhœa recurring, and the blood being again drained of its fluid parts. The result of this treatment was extraordinary. It has simply revolutionised the results, so that, whereas formerly the recovery of a collapsed case was a surprise, its non-recovery is now a disappointment. In severe cases the proportion of chlorides in the blood falls below the normal, notwithstanding the great concentration of the blood from loss of water. He therefore sometimes uses a saline solution of 1·65 per cent., but usually 1·35 per cent. is sufficient. In bad cases the coagulability of the blood is very greatly reduced, so that the author now generally adds 3 gr. of calcium chloride to a pint of saline solution. The development of uræmia in the reaction stage of cholera is associated with a comparatively low blood-pressure; measures to raise it, such as the hypodermic administration of adrenalin and digitalis, are indicated for the prevention and treatment of this very serious complication.—The British fresh-water phytoplankton, with special reference to the desmid-plankton and the distribution of British desmids: W. **West** and G. S. **West**. The paper is in part a comprehensive summary of the known facts concerning the phytoplankton of British fresh waters. It has been possible to institute a close comparison between the British phytoplankton and that of continental Europe, proving that the British lakes are relatively richer in green algæ and poorer in blue-green forms than the generality of continental lakes. The large percentage of green species in the British lakes is due, in most instances, to the dominance of desmids. Certain diatoms also stand out conspicuously, especially some of the large species of the Surirellaceæ. As the plankton investigations were not commenced until the authors had acquired a very extensive knowledge of the general British alga-flora, it has been a comparatively easy matter to see wherein the phytoplankton differs from the algæ of the littoral region and of the bogs, &c. An extended study of the distribution of British desmids has shown that the rich desmid areas correspond (1) to a considerable extent with the areas of greatest rainfall, and (2) to a much closer extent with the outcrops of the older Palæozoic and pre-Cambrian strata. The really rich desmid-floras only occur in those western and north-western districts in which the geological formations are older than the Carboniferous, and these are likewise the districts in which the British lakes are situated. Therefore, the dominance of desmids in the phytoplankton is not so remarkable as might at first be supposed. Numerous desmids are continually washed from the drainage-areas into the limnetic region of the lakes, and some of them have become leading constituents of the phytoplankton either with or without change of morphological characters. Many of them form a well-marked assemblage, the individual constituents of which are limited in their British distribution to the western lake-areas, although most of them occur in the lakes and bogs of Scandinavia on precisely similar outcrops of old rocks. It is suggested that perhaps the most important factor in this relationship is a chemical one, but, so far as observations have been made, ordinary chemical analysis of the drainage-waters has offered no clue to the solution of the problem.—The selective permeability of the coverings of the seeds of *Hordeum vulgare*: Prof. Adrian J. **Brown**. It has been pointed out previously ("Annals of Botany," 1907, vol. xxi., p. 79) that the coverings of the seeds of barley act as an exceptionally perfect semi-permeable membrane, resisting the passage of acids, of alkalies, and of salts, but not of iodine. Experiments are now described from which it appears that not only strong electrolytes, but also dextrose, cane sugar, and other non-electrolytes are unable to penetrate the membrane. On the other hand, mercuric chloride and cyanide, but neither the nitrate nor sulphate, cadmium iodide, but not the chloride nor the sulphate, ammonia, acetic acid and several of its homologues, alcohol and ethylic acetate, are all capable of passing into the corns. Glycollic and lactic acids also pass in, but far less rapidly than acetic. The water-absorbing capacity of the seeds when immersed in various solutions has been contrasted with that of the seeds when placed in water alone. Far less water is absorbed from solutions of substances which do not penetrate the seed covering than from those containing substances which do. In the case of substances which diffuse readily into the corn, such as ammonia and ethylic acetate, the rate at which water passes in is much more rapid than from solutions of substances which do not penetrate the covering, or from water alone.—The origin of osmotic effects, ii., differential septa: Prof. H. E. **Armstrong**. It is shown that the effects described by Prof. Brown may be explained in terms of the theory of the conditions of substances in solution recently communicated to the society by the author. Substances such as ammonia, acetic acid, &c., which exist in solution in a slightly *hydrolated* state, would pass the hydrolated surfaces of the intramolecular passages in the colloid membrane, whilst hydrolated solutes would be held back. The increased rapidity with which water enters in some cases is traceable to the effect which the diffusing substance has in raising the osmotic stress in the water within the corn.

February 4.—Sir Archibald Geikie, K.C.B., president, in the chair.—The electricity of rain and its origin in thunderstorms: Dr. G. C. **Simpson**. During 1907–8, an investigation was undertaken at the Meteorological Office of the Government of India, Simla, into the electrical phenomena which accompany rain and thunderstorms, with results which have led to the following theory. It is exceedingly probable that in all thunderstorms ascending currents greater than 8 metres a second occur. Such currents are the source of large amounts of water, which cannot fall through the ascending air. Hence, at the top of the current, where the vertical velocity is reduced on account of the lateral motion of the air, there will be an accumulation of water. This water will be in the form of drops, which are continually going through the process of growing from small drops into drops large enough to be broken. Every time a drop breaks, a separation of electricity takes place, the water receives a positive charge, and the air a corresponding amount of negative ions. The air carries away the negative ions, but leaves the positively charged water behind. A given mass of water may be broken up many times before it falls, and, in consequence, may obtain a high positive charge. When this water finally reaches the ground, it is recognised as positively charged rain. The ions which travel along with the air are rapidly absorbed by the cloud particles, and in time the cloud itself may become highly charged with negative electricity. Now within a highly electrified cloud there must be rapid combination of the water drops, and from it considerable rain will fall; this rain will be negatively charged. A rough quantitative analysis shows that the order of magnitude of the electrical separation which accompanies the breaking of a drop is sufficient to account for the electrical effects observed in the most violent thunderstorms. All the results of the observations of the electricity of rain described in the paper are capable of explanation by the theory, which also agrees well with the actual meteorological phenomena observed during thunderstorms.—The effect of pressure upon arc spectra, No. 3, silver, λ 4000–λ 4600: Dr. W. G. **Duffield**. This paper is the third that the author has presented to the Royal Society upon the effect of pressure upon arc spectra. The behaviour of the iron, copper, and silver arc spectra (region $\lambda\lambda$ 4000–4600) has now been described, the former under pressures up to 100 and the last two up to 200 atmospheres. In course of time the

author hopes to publish the results of investigations upon the spectrum of gold, iron, and nickel under pressures up to 200 atmospheres, and of other regions of the copper and silver spectrum up to the same pressure. Photographs of all these have been obtained.—The tension of metallic films deposited by electrolysis: G. G. **Stoney.** It is well known that metallic films deposited electrolytically are in many cases liable to peel off if deposited to any considerable thickness, especially in the case of nickel, which, if deposited above a certain thickness, curls up into beautiful close rolls in cases where the film does not adhere closely to the body on which it is deposited. The late Earl of Rosse, F.R.S., also found it impossible to produce flat mirrors electrolytically on account of the "contraction" of the coat of copper, and the author has observed similar phenomena in protecting the silver film of searchlight reflectors when the thickness of the copper coat was above 0·01 mm. Dr. Gore, F.R.S., and others have observed similar phenomena. These phenomena would be explained if the metal were deposited from the solution under tension, and it was found that when a thin steel rule was coated on one side with nickel it became bent, even to the extent of 3 mm. or 4 mm. in 100 mm. This bending could not be caused by any difference of expansion between nickel and steel, as the whole was immersed in the depositing solution, and this was at a constant temperature. From the thickness of the rule, the amount of nickel deposited, and the bending, the tension under which the film was deposited was calculated, and found to amount to 2840 kilos. per square cm., or 18·1 tons per square inch. It was also found that this tension was independent of the temperature and strength of the solution, as well as the current density, so long as the deposit was a good dense one. When the rules were heated to a red heat to anneal them, the deflection was reduced to from one-third to one-half the original.—A further note on the conversion of diamond into coke in high vacuum by kathode rays: A. A. Campbell **Swinton.** In a previous paper on this subject by the Hon. Charles A. Parsons and the writer (Proc. Roy. Soc., A, vol. lxxx., pp. 184–5), experiments were described designed to ascertain whether any gas was emitted by diamond during its conversion into coke. The present note has reference to further and more detailed investigation, made on the suggestion of Mr. Parsons by the writer, with special regard to the possibility of diamonds containing neon, krypton, or other rare gas which would be emitted on the diamond being converted into coke. As before, spectrum tubes connected with the kathode-ray furnace were sealed off so as to contain samples of the residual gas before and after the conversion. The spectra of these were compared both photographically and also by direct visual examination in the spectroscope, with the result that, though differences were observed in regard to the relative brightness of various individual lines in the two spectra, careful observation showed that in no single instance was there any line in one spectrum that could not be obtained in the other by suitably adjusting the strength of the electric discharge through the spectrum tube. From this it would appear that the conversion of diamond into coke, if it sets free any gas at all, at any rate does not liberate any other than one or more of the comparatively common gases that are generally found as residuals in kathode-ray tubes exhausted from air in the ordinary way. Though this is a negative result, it has been thought well to put it on record.

Geological Society, February 10.—Prof. W. J. Sollas, F.R.S., president, in the chair.—Note on some geological features observable at the Carpalla china-clay pit in the parish of St. Stephen's (Cornwall): J. H. **Collins.** An east-and-west fault traverses this pit near its southern wall, with a downthrow to the south of more than 50 feet. North of the fault there is china-clay rock or "carclazyte," at one point underlying granite not sufficiently altered to yield china-clay, and sometimes containing embedded lenticles or irregular masses of partly kaolinised granite. South of the fault there is nearly horizontal tourmaline-schist. Underlying the schist there occurs also china-clay rock to a distance of many fathoms from the fault. This occurrence of china-clay under a thick schistose overburden is unique in Cornwall. It is maintained that this example is in favour of the pneumatolytic origin of carclazyte, the gases producing the change being possibly in part carbonic acid, but probably to a more important degree chlorine, fluorine, and boron.—Some recent observations on the Brighton cliff-formation: E. A. **Martin.** Features presented by the face of the cliffs between successive falls at Black Rock, Brighton, during the past eighteen years are recorded. As the cliffs have worn back, the base-platform of Chalk grows in height, and the layer of sand above the Chalk grows thinner and thinner, until it disappears. The raised beach has grown in thickness from 1½ feet to 12 feet. In 1890 there were 6 feet of sand, with a foot and a half of beach above it. In 1892 the sand had decreased to between 3 feet and 4 feet, but the beach remained as in 1890. Many falls of cliff took place between 1892 and 1895, and at the latter date the beach had increased to between 4 feet and 5 feet. The eastern limit of the beds had become more clearly defined. In 1897 10 feet of chalk formed the lower portion of the cliff, with 8 feet of raised beach above it in places, but there was a mere trace of sand left. In 1899 the raised beach had reached a thickness of 10 feet. Great masses of moved and reconstructed chalk were observed on the eastern boundary embedded in the beach. In 1903 the beach was but a little more than 8 feet thick in the exposed parts, but the platform of Chalk was 14 feet thick. In 1906 the raised beach had increased from 15 feet to 20 feet; farther west, however, the thickness was not so great. In 1908 there were 17 feet of Chalk, 12 feet of beach. If the material is to be prevented from disappearing into deep water, some such contrivance as chain-cable groynes seems to be demanded, fixed somewhere between low and high tide-marks.

Physical Society, February 12.—Dr. C. Chree, F.R.S., president, in the chair.—Annual general meeting.—Presidential address: Dr. **Chree.** An account was given of some work the president had recently been engaged in, in connection with the reduction of the magnetic observations of the National Antarctic Expedition of 1902–4. This referred to an inter-comparison of simultaneous records of magnetic disturbances obtained in the Antarctic and at the observatories of Kew, Falmouth, Colaba (Bombay), Mauritius, and Christchurch (New Zealand). He exhibited a number of lantern-slides showing the sudden commencement of some magnetic storms, and the forms of some special types of disturbance observed in the Antarctic. Some results were given as to the directions and intensities of the disturbing forces to which the disturbances recorded at the different stations might be attributed.

Royal Meteorological Society, February 17.—Mr. H. Mellish, president, in the chair.—Report on the phenological observations for 1908: E. **Mawley.** The most noteworthy features of the weather of the phenological year ending November, 1908, were the severe frosts early in January, the exceptionally heavy fall of snow and remarkably low temperatures in the latter part of April, and the marked periods of unusually wet and dry weather during the summer. In February and March wild plants came into blossom in advance of their usual time, but throughout the rest of the flowering season were more or less behind their average dates. Such early spring migrants as the swallow, cuckoo, and nightingale made their appearance very late. The only deficient farm crop was that of barley. The yield of wheat, oats, and beans was rather above the average, that of peas and hay very good, while the crops of turnips, mangolds, and potatoes, taken together, were the most abundant for many years.—The cold spell at the end of December, 1908: W. **Marriott.** The most remarkable feature was the intense cold which prevailed over the central and south-eastern portion of England on December 28–31. At several places the lowest temperature recorded was about zero. For the month of December the cold was very exceptional, as the only instances in the neighbourhood of London or at Greenwich in which the maximum temperature was below $25^{\circ}\cdot5$ for the day were the following:—1796, 25, $19^{\circ}\cdot5$; 1798, 28, $19^{\circ}\cdot5$; 1816, 22, $24^{\circ}\cdot0$; 1830, 24, $22^{\circ}\cdot0$; 1855, 21, $23^{\circ}\cdot2$; 1874, 31, $24^{\circ}\cdot5$; 1890, 22, $23^{\circ}\cdot7$; and 1908, 29, $25^{\circ}\cdot4$, and 30, $23^{\circ}\cdot3$.

CAMBRIDGE.

Philosophical Society, January 25.—Sir J. J. Thomson, vice-president, in the chair.—A string electrometer: T. H. **Laby**. An electrometer consisting of a stretched silvered quartz-fibre between two charged plates was shown. Tested on steady potentials it had the following properties:—(1) The sensitiveness for a constant fibre tension increased rapidly with increasing potential difference between the plates. (2) With the plates at 0·7 mm. apart and charged to +10 volts and −10 volts the sensitiveness was more than 70 eye-piece divisions per volt. (3) The deflection of the fibre is proportional to its potential. (4) When not very sensitive it may be used as an oscillograph. Further work is being done on this application of it.—The secondary Röntgen radiation from air and ethyl bromide: J. A. **Crowther**. The amounts of secondary Röntgen radiation from air and ethyl bromide have been compared, using ethyl bromide as the absorbing gas. The results in the main confirm those previously obtained with air as the absorbing medium. Corrected results for the relative amounts of secondary radiation from these gases are given.—Interference fringes with feeble light: G. I. **Taylor**. Interference photographs were taken with light of such small intensity that single exposures extended over several months. The fact that they were well defined was taken to indicate an upper limit to the magnitude of the indivisible unit of energy occurring in the non-homogeneous wave-front theory of light.—The solution of linear differential equations by means of definite integrals: H. **Bateman**.

February 8.—Mr. S. Ruhemann, vice-president, in the chair.—Further studies on dihydroxymaleic acid: Dr. **Fenton** and W. A. R. **Wilks**. The authors are continuing the investigation of the properties and transformations of dihydroxymaleic and dihydroxytartaric acids, and in the present communication a brief account is given of some recent results.—Homologues of furfural: Dr. **Fenton** and F. **Robinson**. New syntheses have been effected by the application of the Friedel and Crafts reaction to the halogen derivatives of methylfurfural with various hydrocarbons, and the results promise a wide field for further investigation.—Action of urethane on esters of organic acids and mustard oils: S. **Ruhemann** and J. G. **Priestley**. The sodium-derivative of ethyl carbamate reacts with ethyl phenylpropiolate, not by addition, but with formation of ethyl phenylpropiolylcarbamate. Similarly, the esters of fatty saturated acids furnish acid derivatives of ethyl carbamate. Phenyl mustard oil reacts with ethyl sodiocarbamate, and yields the anhydride of diphenylthiobiuretcarboxylic acid. Besides this compound, a small quantity of carboxyethylphenylthiocarbamide is formed. Analogous is the action of ethyl sodiocarbamate on other mustard oils.—The absorption spectra of solid tetramethyl picene and of its solutions: Annie **Homer** and J. E. **Purvis**. The absorption bands of a very thin film of the hydrocarbon were compared with those when the substance was in solution in benzene and in alcohol. The results showed that the three bands were identical in each case, but that there was a shift of both the bands and the general absorption towards the red end of the spectrum, according to the density of the medium. The bands of the solid were shifted towards the red end of the spectrum more than those of the benzene solution, and those of the benzene solution more than in the alcoholic solution. The vapour of the substance was also examined, and it showed a beautiful blue fluorescence, but it decomposed so rapidly that no observations could be made as to its fluorescent spectrum.—The absorption spectra of mesitylene and trichloromesitylene: J. E. **Purvis**. The absorption spectra of N/1000 alcoholic solutions were compared, and the absorption curves were drawn from the numbers obtained. It was found that there was a shift of the bands of the trichloromesitylene towards the red end of the spectrum when compared with those of mesitylene. The strong band of mesitylene, λ 275–λ 245, was shifted in the trichloromesitylene to λ 287–λ 263, and, besides that, the persistence of the absorption curve of the latter was considerably increased.—The absorption spectra of concentrated and diluted solutions of chlorophyll: J. E. **Purvis**. The ratio of the dilutions was 1/719, and the diluted solution was placed in a tube 719 times larger than that containing the strong solution. The light, therefore, passed through the same amount of chlorophyll. The two solutions showed exactly the same phenomena at the commencement of the observations. The bands at λ 538 and λ 565 were equally well marked, and the general absorption was the same. After standing some hours, the diluted solutions showed changes in the appearance of the bands; λ 538 became more diffuse, and λ 538 and λ 565 appeared to diffuse into each other, whilst a band at λ 508 appeared, and the general absorption was almost the same as at the commencement. The change continued very slowly for several days. The final result showed that in the strong solution the band λ 538 was as well marked as at the beginning, and that the band λ 508, which appeared after some hours, remained the same, and the band λ 565 appeared to be the same as at the beginning. On the other hand, the general absorption had lessened very considerably as compared with the dilute solution. These changes are ascribed to the action of enzymes, probably oxydases.—A coloured thio-oxalate: H. O. **Jones** and H. S. **Tasker**. Diphenyldithio-oxalate is readily prepared by the action of oxalyl chloride on thiophenol, and crystallises in beautiful bright yellow prisms melting at 119°–120°. The compound is the first dithio-oxalate known, and it is interesting in that it is coloured, while oxalates are colourless. It appears to distil unchanged, decomposes into thiophenol and potassium oxalate when boiled with caustic potash, and gives off carbon monoxide when treated with sodium or sulphuric acid.—Note on some double fluorides of sodium: W. A. R. **Wilks**. Cryolite, a double fluoride of sodium and aluminium, has already been prepared synthetically. The author shows that by carrying out the precipitation in a different way another double fluoride is obtained, which is so insoluble that it may be used as a test for sodium.

PARIS.

Academy of Sciences, February 15.—M. Émile Picard in the chair.—The construction of orthogonal systems which comprise a family of Dupin cyclids: Gaston **Darboux**.—The tectonic of the Palæozoic strata at the north-west and north of Sablé (Sarthe): D. P. **Œhlert**.—M. Jungfleisch was elected a member in the section of chemistry in the place of the late A. Ditte.—Observations of the comet 1908*c* (Morehouse), made at the Observatory of Athens with the Gautier 40-cm. equatorial: D. **Eginitis**. Four sets of observations, made on November 28, December 1, 3, and 4, 1908, are given for this comet, together with the apparent positions of the comet and mean positions of the comparison stars.—Selective effect in the ionisation of a gas by an alternating field: Henry A. **Perkins**.—The melting point of platinum: C. **Féry** and C. **Chéneveau**. The Féry absorption pyrometer used in these experiments, the indications of which, based on Wien's law, are only accurate for a black body, was calibrated against a Le Chatelier couple. The platinum was fused in two ways, by passing an electric current through a wire placed in a horizontal and a vertical position, and by heating in a suitable gas burner. The melting points obtained varied from 1690° C. to 1750° C. The variations in the melting point appear to be related to the nature of the gas in which the fusion is produced.—The reversal of the green radiation produced by the mercury arc in a vacuum: A. **Perot**.—The influence of the extreme regions of the spectrum in phenomena of solarisation: A. Gargam **de Moncetz**.—The compressibility of gases between 0 and 3 atmospheres and at all temperatures: A. **Leduc**. A re-calculation for twenty gases of the constants required for determining their molecular volumes at 0° C. and 100° C.—The thermal phenomena accompanying the action of water on aluminium powder: E. **Kohn-Abrest** and J. **Carvallo**. Water acts on aluminium with evolution of heat (about 1700 calories per gram) at a temperature of about 83° C.—The magnetic properties of some easily liquefiable gases: P. **Pascal**. The values of the specific magnetic susceptibility are given for eight gases in the liquid state, and, on the assumption that the specific susceptibility is independent of its physical state, the values for this constant for the same gases at 0° and 760 mm. pressure are calculated.—The catalytic oxidation of hypophosphorous acid by copper: J. **Bougault**. Precipitated

copper exerts a catalytic action on hypophosphites, hydrogen being given off; one gram-molecule of copper was found to produce 30 gram-molecules of hydrogen in this way.—An exception to the general method of preparation of aldehydes by means of the glycidic acids: René **Pointet.** The general method indicated by Darzens does not give the expected diphenylacetic aldehyde, the glycidic ester splitting up into diphenylacetic acid and carbon monoxide instead of into carbon dioxide and the corresponding aldehyde.—Some halogen derivatives of γ-oxycrotonic acid: MM. **Lespieau** and **Viguier.**—Theory of the colour reactions of dioxyacetone in sulphuric acid solution: G. **Denigès.** Methylglyoxal, in sulphuric acid solution, gives the same colour reactions with alkaloids as dioxyacetone, and it is probable that the latter is converted into methylglyoxal in these reactions by the acid.—The oxidation of alcohols by the simultaneous action of tannate of iron and solution of hydrogen peroxide: E. **de Stœcklin.** Methyl, ethyl, normal propyl, and normal butyl alcohols are oxidised to aldehydes by hydrogen peroxide in presence of tannate of iron, as also are the alcohols glycol, glycerol, and sorbitol. Capryl, isopropyl, and isobutyl alcohols resist this oxidation.—Castration in *Zea mays*, var. *tunicata*, produced by *Ustilago maydis*: M. **Chifflot.**—Variations in grafted vines: F. **Baco.**—The influence of grafting on some annual plants, and plants living by their rhizomes: Lucien **Daniel.** Details of experiments, spreading over thirteen years, on the grafting of the potato on the tomato, and of Helianthus provided with rhizomes (*H. tuberosus, lactiflorus,* and *multiflorus*) on an annual (*H. annuus*).—The phytogeographical divisions of Algeria: G. **Lapil.**—The anatomical distinction of the genera Lithothamnion and Lithophyllum: Mme. Paul **Lemoine.**—A case of abnormal multiple cephalisation in Syllidians in stolonisation: Aug. **Michel.**—A special method of electrodiagnosis: M. **Guyenot.** An application of the instantaneous discharge of a condenser through an induction coil without an iron core to the quantitative study of the electrical stimulation of nerves. It has proved of practical service in the detection of cases of feigned paralysis.—Prehistoric rock engraving discovered at Île-d'Yeu (Vendée): Marcel **Baudouin.**—Seismic movements of February 9, 1909: Alfred **Angot.**—The solution of ferruginous dust of cosmic origin in the sea: M. **Thoulet.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 25.

ROYAL SOCIETY, at 4.30.—The Statistical Form of the Curve of Oscillation for the Radiation emitted by a Black Body: Prof H A. Wilson, F.R.S.—The Flight of a Rifled Projectile in Air: Prof. J. B Henderson.—On the Cross-breeding of Two Races of the Moth *Acidalia virgularia*: L. B. Prout and A. Bacot

ROYAL INSTITUTION, at 3.—Problems of Geographical Distribution in Mexico: Dr. Hans Gadow, F R.S

ROYAL SOCIETY OF ARTS at 4.30.—The Bhuddist and Hindu Architecture of India: Prof. A. A. Macdonell

INSTITUTION OF ELECTRICAL ENGINEERS, at 8—*Further discussion*: The Use of Large Gas Engines for Generating Power: L. Andrews and R. Porter.

FRIDAY, FEBRUARY 26.

ROYAL INSTITUTION, at 9.—Osmotic Phenomena, and their Modern Physical Interpretation: Prof. H. L Callendar, F.R.S.

PHYSICAL SOCIETY (at Finsbury Technical College, Leonard Street, City Road, E.C.), at 5.—A Laboratory Machine for applying Bending and Twisting Moments simultaneously: Prof. Coker.—On the Self-demagnetising Factor of Bar Magnets: Prof. Silvanus P. Thompson, F.R.S., and E. W. Moss.—Exhibition of Optical Properties of Combinations of Mica and Selenite Films (after Reusch and others) in Convergent Polarised Light: Prof. Silvanus P. Thompson, F.R S.—Exhibition of Apparatus: C. R. Darling.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Standardisation in Engineering Practice: Dr. W. C. Unwin, F.R.S.

SATURDAY, FEBRUARY 27.

ROYAL INSTITUTION, at 3.—Properties of Matter: Sir J. J. Thomson, F R.S.

MONDAY, MARCH 1.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—On some Requirements of a Colour Standard: J. W. Lovibond —Sulphur as a Cause of Corrosion in Steel: G. N. Huntly.

ROYAL SOCIETY OF ARTS, at 8.—Modern Methods of Artificial Illumination: Leon Gaster.

TUESDAY, MARCH 2.

ROYAL INSTITUTION, at 3.—The Evolution of the Brain as an Organ of the Mind: Prof. F. W. Mott, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—The Development of the Sub-divisions of the Pleuro-peritoneal Cavity in Birds, illustrated by Lantern-slides: Miss Margaret Poole.—The Growth of the Shell of *Patella vulgata*, L.: E. S. Russell.—The Life history of the Agrionid Dragon-fly: F. Balfour-Browne.—Growth-stages in the British Species of the Coral Genus Parasmilia: W. D. Lang.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Some recent Grain-handling and Storing Appliances at the Millwall Docks: M. Mowat.

FARADAY SOCIETY, at 8.—On the Rate of Evolution of Gases from Homogeneous Liquids: V. H. Veley, F.R S., and Dr. J. C Cain.—The Electro-analysis of Mercury Compounds with a Gold Kathode: Dr. F. Mollwo Perkin —The Relation between Composition and Conductivity in Solutions of *meta-* and *ortho*-Phosphoric Acids: Dr. E. B. R. Prideaux.

WEDNESDAY, MARCH 3.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Composition of Cider: B. T. P. Barker and E. Russell.—The Composition and Analysis of Chocolate: N. P. Booth, C H. Cribb, and P. A Ellis Richards.—Note on the Determination of Petroleum in Turpentine: J. H. Coste.

ENTOMOLOGICAL SOCIETY, at 8.—Birds as a Factor in the Production of Mimicry among Butterflies: Guy A. K. Marshall.

THURSDAY, MARCH 4.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Presence of Hæmagglutinins, Hæm-opsonins, and Hæmolysins in the Blood obtained from Infectious and Non-infectious Diseases in Man (Second Report): L. S. Dudgeon.—The Action on Glucoside by Bacteria of the Acid-fast Group, with a New Method of isolating Human Tubercle Bacilli directly from Tuberculous Material contaminated with other Micro-organisms (Preliminary Note): F. W. Twort.—The Effect of Heat upon the Electrical State of Living Tissues: Dr. A. D. Waller, F.R.S.

ROYAL INSTITUTION, at 3.—Problems of Geographical Distribution in Mexico: Dr. Hans Gadow, F.R.S.

RÖNTGEN SOCIETY, at 8.15.—Some Vacuum Tube Phenomena: A. A. Campbell Swinton.

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